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THE EFFECT OF WAVE FORM UPON INCANDESCENT LAMPS.

In an earlier period of the history of incandescent lamps a few investigations were made as to whether the lamps were differently affected when used with direct and alternating currents. No certain evidence of any differences of this kind was found. The generalization seems to have been made from this that there was no difference in the effect upon the lamp so long as the effective voltage was kept the same. It is true that when metallic-filament lamps were first brought into use it was found that the life was shorter when they were used with alternating current than when they were used with direct current, especially in the case of tantalum. This result was attributed, however, to the mechanical vibration or other incidental conditions which accompanied the use of alternating current.

In a paper to be found upon other pages of this issue it is shown that differences in the watts consumed, in the candlepower and in the life of lamps, used with alternating current and with continuous current, are to be expected, and that such differences attain a very appreciable magnitude at frequencies as low as twenty-five cycles. The theoretical investigation makes it clear that similar differences exist with all lamps, but that they only attain an appreciable magnitude when the frequency is so low or the heat capacity of the filament is so low that the temperature of the filament does not remain sensibly constant over a complete cycle. Previous work has shown that even with carbon lamps the fluctuations of candlepower during a cycle are very noticeable. It does not seem to have been noticed at that time, however, that the average candlepower during the cycle was different from the steady candlepower which would be obtained when the lamps were subjected to a continuous voltage of the same effective value.

Perhaps the most surprising part of this investigation is the fact that with metal filaments the power consumption is less with alternating current than with continuous current, and yet the candlepower is greater. In other words, the average efficiency is increased. The practical application of this fact and the accompanying effect upon life is that a lamp should be differently rated for use upon a twenty-five-cycle circuit and upon a continuous-current cir-

cuit. It should be noticed that life tests should not be carried on at twenty-five cycles, if the lamps are to be used upon a circuit of sixty cycles or higher, or with direct current. The differences found between direct current and twenty-five-cycle alternating current are an indication of what would be found upon different alternating circuits where the wave forms are unlike. Since a continuous current represents the condition of a flat wave, it is evident that a wave form which was more peaked than a sine wave would give results even further removed from those found with direct current.

A similar effect to that here investigated is to be expected in the use of hot-wire measuring instruments where the resistance of the conductor and consequently the amount of power expended in the instrument depends upon the temperature attained. If this temperature varies during a cycle the amount of power will be different with direct and alternating currents and will vary with the wave form. Since the relation between change of length and temperature is approximately linear, it may be assumed that the indication of such an instrument will be proportional to the amount of energy expended in it. In the case of a voltmeter the energy will be less and in the case of an ammeter it will be greater with alternating current than with direct current.

Hot-wire instruments do not usually have a sensibility and an accuracy which warrants their use in measurements where these small effects would be important, but in the use of such an instrument as the alternating-current-direct-current comparator this effect might easily become appreciable and would introduce error into the measurement. Before such an instrument can be relied upon, therefore, it is necessary that any effect of this kind should be investigated.

MULTIPLEX TELEPHONY.

There have been a number of methods invented for multiplex telegraph operation. Some of these have been experimentally demonstrated with success, although the application on commercial lines of a system sending more than four simultaneous messages does not seem to have been introduced. With multiplex telephony the problem has been more difficult. It seems at last to have been solved by Major George O. Squier and his associates in the Signal Corps of the War Department. Upon other pages of this issue will be found a description of the method which has been evolved and which although covered by patent rights, is offered to the public for general use.

This method is based upon the superposition on a single circuit of a number of currents of different frequencies and the use of selective apparatus for isolating each component at the receiving end. This separation is accomplished by the use of individual transformers whose secondaries are connected in a circuit tuned to correspond with the particular frequency which is to be selected. The frequencies chosen are sufficiently high to be beyond the limits of audibility and consequently any effect in the receiving telephone is due not to these rapid vibrations themselves but to the variation in the effective value of the currents, which effective value changes with a frequency which is audible to the ear.

According to announcements made, not only may a number of telephone conversations be thus carried on upon the same line, but it is possible to send at the same time telegraph messages, that is to say, messages which are transmitted with the ordinary key and received upon the ordinary sounder. The principle of separation is here the same as with the telephone messages.

The method involved in this new invention is so simple that, like many others, after it is once explained one wonders why it is has not been utilized before. The operations are similar to the famous experiments of Helmholtz in analyzing sound waves into their various constituents by the use of apparatus which was tuned to pick out the various components of a complex sound. The secret of the success here lies in using for the various components employed frequencies which are themselves inaudible and therefore produce no appreciable effect in the telephone, for if these vibrations were taken up by the diaphragm and were audible they would so interfere with the sound of the useful vibrations as to disguise them beyond recognition.

According to Mr. Frank L. Perry, this is not the first time that more than one telephone message has been sent over a single circuit. According to the claims of Mr. Perry, such a feat was performed in Chicago over two years ago, but without a knowledge of the method used by Mr. Perry it is impossible to make any comparison between his accomplishment and that achieved in the Washington laboratory.

Major Squier is to be complimented not only upon his evolution of what promises to be a very useful invention, but also upon his action in giving the results of his time and labor to the public. While many persons regard this as the only proper thing to do in the case of one who is in the public service, it is not always that such obligations are recognized, so that the public receives the benefit.

AN INSTANCE OF CO-OPERATION.

A railway company which has been operating in one of the largest cities in Oklahoma has been seeking for means to improve its schedules and to this end deemed it desirable to stop only at every second street crossing. Before taking definite steps, however, cards were distributed through the city with the request that those interested should give an opinion regarding such a change of stopping points.

This question, like all the others which come up between the public and the companies operating public utilities, has not two, but many sides. The public wishes the best and most convenient means of transportation, but there may be a great diversity of opinion as to what constitutes the most conve-

nient method for the majority. Naturally the company has a desire to improve its schedules both as a convenience to those using its lines and to cut down its car equipment.

Too often the decision of a public-service corporation is made with a sincere endeavor to please the public, only to discover after the change decided upon has been made, that the public wanted nothing of the kind.

It cannot be too strongly urged that public-utility companies should find out definitely what the public wants, if a change is to be made for the convenience of that public which the company serves. Aside from the fact that such co-operation will inevitably produce a more friendly feeling toward the operating company, it would make a number of problems more easy of solution.

PUBLIC-SERVICE RATES AND DEPRECIATION.

It has not been many years since the public-service corporation was regarded in the same way as any commercial or manufacturing company and was expected to do business along the same lines. With the realization of the fact that, in view of franchises, rights of eminent domain, and the naturally monopolistic character of its business, it belonged in a different category, came the movement for commission regulation and control of rates. This movement has gathered impetus until now we have the regulating function exercised by the Interstate Commerce Commission, by state commissions in many of our states, and by many city governments.

The general principles which should govern the fixing of rates where there is no real competition, are pretty well established, and these are also being applied to corporations whose business is a natural monopoly depending upon franchise grants, even though there may be apparent opportunity for or real existence of competition. To the actual operating expenses, including reasonable overhead, advertising and office expenses, are added the items of maintenance, insurance, taxes, reserve for depreciation, return on the investment and any legitimate payments which must be made by the company in the nature of royalties, percentage of gross receipts to a city government, etc. Rates should then be fixed so as to return gross receipts at least equal to this total and not exceeding it by an excessive amount.

While some of the above items are easily fixed, others, such as depreciation and return on the investment, often become mooted questions. Long operating experience is necessary to make a proper allowance for depreciation anything more than a matter of good judgment, common sense or mere personal opinion. And even long experience will not give an exact answer to the question in the case of those utilities whose equipment is subject to considerable change from time to time. A proper return on the investment should certainly exceed the customary interest returned from safe and secured investments requiring only ordinary prudence and caution in placing, since the investment of an operating company involves some risk, efficiency and enterprise in management, and very often an intrinsic value as a going concern due to the efforts and the ability of its officers. Some inducement must exist to attract capital to such enterprises, or extensions and enlargements become impossible. This difference between the actual return and customary interest is sometimes designated as profits in distinction from interest, and its proper amount is a common point of debate.

With regulation of rates in progress or in prospect, every public-utility corporation should see that all of the above items are properly carried on its books, a condition which has often not existed in the past. It has been very common, as in the case of most manufacturing and other concerns, to confuse the accounts for new construction, for maintenance, and for depreciation. New construction should of course be kept distinct, since it represents an increase in investment which should not be supplied by current receipts. It is very much harder to distinguish between expenditures which are made for maintenance and for depreciation, since certain repairs may be charged to either account. In fact, in the case of a plant which has been running for a long period, the yearly expense for depreciation may approximately equal the yearly allowance for depreciation and the necessity for keeping the depreciation account separate from the maintenance account becomes less obvious. This practice in a new concern, however, will entail abnormally low charges for the combined fund in the early years and abnormally high expenses in later years.

An illustration of the advisability of keeping these accounts separate is furnished by the Chicago Telephone Company, a report concerning which has recently been filed by an expert in the employ of the City Council. Owing to the Company's failure to set aside a distinct reserve for depreciation, and to make replacements from this fund, it is assumed that no funds have been expended for this purpose. Consequently the value of the plant is assumed to have decreased 22.5 per cent below its cost, this figure being computed from the life of the various elements of the plant. This assumption seems entirely unwarranted, as there is nothing in the report to show that the plant has actually deteriorated, and that the maintenance charges do not include replacements, since it is admitted that the service is efficient and the equipment all that can be desired. Even admitting that the plant has deteriorated, it seems unreasonable to reduce the value of the investment upon which fixed charges are to be paid, unless it can be shown that excessive dividends have been returned to stockholders in the past, instead of being held as a replacement fund. Such dividends might in that case be regarded as a partial return of capital. Since the application of the principle of a depreciation reserve has been widely recognized only in comparatively recent years, it would seem unfair to penalize a company for failing to live up to this principle in the past.

CURRENT-SAVING DEVICES.

ADDRESS BEFORE THE ELECTRIC CLUB OF CHICAGO.

At the regular weekly meeting of the Electric Club of Chicago, held on Wednesday, January 7, A. J. Francis, of the Chicago office of the Fort Wayne Electric Works, spoke on the subject of current-saving devices and of their place in extending and furthering the use of electricity.

Mr. Francis stated, in opening, that although the modern central station was continually on the outlook for new ways in which to increase the sale of current, it often lost sight of the fact that the sale of current-saving devices could with proper attention be made to be one of the most important factors in popularizing electricity. The best known of these current-savers is naturally the tungsten lamp, and yet many companies have not pushed sales in this direction for fear that the customers might use less current and lower the total consumption. Many householders would add lamps to their circuits when they clearly understood the economy of the Mazda lamp, and without doubt the company on making a feature of the lower lighting cost would secure many new customers. At present it is not uncommon to find gas jets burning in a house illuminated by electricity, a state of affairs which the Mazda lamp does much to eliminate. The Mazda lamp is such an improvement over the old carbon lamp that it is a little difficult to convince the customer of the increased economy, but once convinced he converts others.

Other current-saving devices were mentioned and the bell-ringing transformer was mentioned as a means of making a customer more permanent, even if the current he used was inconsiderable.

At the close of Mr. Francis's paper Arthur Bessey Smith, who was called upon for a talk concerning the automatic telephone, spoke briefly concerning the spread of these installations, and the remarkable results achieved in the development of the automatic idea.

C. W. Bender, of the National Electric Lamp Association, gave some interesting facts regarding the new lamp with the drawn-tungsten filament. The metallic tungsten to be used in these lamps is cold rolled and is drawn through diamond dies, and with this wire, remarkable lives have been attained. The new method of mounting the filaments makes them capable of standing about five times as much as the ordinary squirted-filament type. The filament seems to last equally well on direct or alternating current, and a rather remarkable feature is that even after it has been run for some time it remains, in some positions, perfectly ductile, and is so tough that it must be laid on steel in order to be cut. Portions of these used filaments have been found to be brittle, but it is believed that before the lamps are perfected, the entire filament can be made of this tough structure, so that it can be broken without actually destroying the lamp bulb.

New Allis-Chalmers Head.

The resignation of President W. H. Whiteside of the Allis-Chalmers Company, Milwaukee, Wis., and the election of D. W. Call to succeed him, have been announced.

Interest in the election of Mr. Call was increased by the fact that he is looked upon as a representative of the interests in the company which are also identified with the American Steel Foundries Company. Mr. Call has been assistant to President W. V. Kelley of that company.

The new president will make his headquarters in Milwaukee. The reasons for President Whiteside's resignation have not been learned. He has been the head of the company for about six years.

New Subways Projected for Boston.

Two tunnel projects involving an expenditure of about $6,100,000 are favored in a report which was recently submitted to the Massachusetts Legislature by the joint board of the Boston Transit Commission and the Board of Railroad Commissioners.

The two tunnels advocated would establish a through line between Harvard Square in Cambridge and Andrew Square in South Boston—Dorchester by way of Beacon Hill, Park Street station and the South station and other way stations, and the joint board suggests that the trains should make the full run.

Western Society of Engineers.

The annual election of the Western Society of Engineers resulted in the choice of the following named gentlemen as the officers of the society for the year 1911:

President—O. P. Chamberlain, chief engineer, Chicago & Illinois Western Railroad.

First Vice-President—W. C. Armstrong, terminal engineer, Chicago & Northwestern Railway.

Second Vice-President—C. R. Dart, bridge engineer, Sanitary District of Chicago.

Third Vice-President—I. O. Baker, professor of civil engineering, University of Illinois, Urbana, Ill.

Treasurer—Albert Reichman, resident engineer, American Bridge Company.

Trustee (for three years)—E. McCullough.

The hold-over trustees are G. M. Brill and W. W. Curtis.

The annual meeting and dinner of the society was held on the evening of January 11 at the Hotel La Salle, Chicago. A report of this meeting will be given in the next issue.

Civil Service Examinations.

The United States Civil Service Commission, Washington, D. C., announces that on February 8 and 9, 1911, examinations will be held at the regular places for the purpose of securing eligibles to fill eleven vacancies in the position of deck officer, and two vacancies in the position of aid, and other vacancies as they may occur in the Coast and Geodetic Survey. Examinations will be held on the same days for topographic draftsman and copyist topographic draftsmen. Those wishing to take either examination should apply for Application Form 1312. These may be obtained from the secretary of any board of examiners.

Copper Companies Merge.

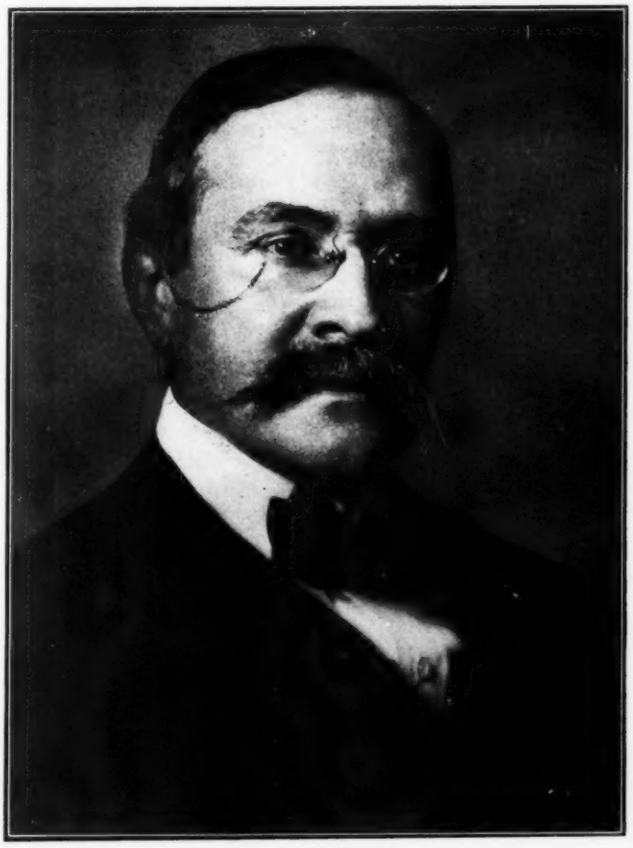
A new copper combination has been effected by the recent merging by the Calumet & Hecla Mining Company, of the twelve Lake Superior copper companies controlled by it.

The companies which it was decided to combine into one corporate ownership are: Calumet & Hecla, Osceola, Tamarack, Ahmeek, Superior, Isle Royale, Centennial, Allouez, La Salle, Seneca, Laurium and Gratiot.

Louis Duncan.

In the present generation of men who have contributed largely to the development of the electrical industry and whose engineering achievement has placed them in the front rank of those entitled to the encomiums and plaudits of a grateful community there have been several graduates of the Naval Academy at Annapolis. Conspicuous among those who have been trained in the naval arm of the United States service is the subject of this sketch, Louis Duncan.

Louis Duncan is an engigineer by profession and occupation. He graduated from the United States Naval Academy in 1880. After graduating he spent about six years in the service, part of the time being on special duty at the Johns Hopkins University, Baltimore, assigned by the Navy Department to assist in the work of determining the absolute unit of electrical resistance for the United States Government. He resigned from the Navy in 1886 and took charge of a course of electrical engineering at Johns Hopkins University, continuing there for fourteen years. During this time he was occupied in other engineering work and was engineer and had charge of the construction of a number of electric roads in Baltimore, Md. He was consulting engineer for practically all of the electrical roads in Washington, D. C., was chief engineer and had charge of the construction of the Third Avenue Railroad system in New York City, was engineer for the independent telephone system in Baltimore, and the system in Pittsburg, Pa. He designed and constructed the Keystone Telephone Company's plant in Philadelphia, Pa. He was engineer for the Baltimore & Ohio Railroad Company in its work of equipping the Baltimore tunnel with electric locomotives for hauling the trains through the center of Baltimore, and he has been consulting engineer for a number of other railroads and lighting propositions. He was consulting engineer for the Rapid Transit Commission of New York City.



LOUIS DUNCAN,
Consulting Engineer.

In 1899 he resigned from the Johns Hopkins University and continued his work as consulting electrical engineer. In 1902, Massachusetts Institute of Technology built a new electrical laboratory and separated the course in electrical engineering from the department of physics. He was called upon to inaugurate this course and remained as the head of this engineering department until 1904. He received the degree of Ph. D. from Johns Hopkins University in 1885. He served as major of the First Volunteers during the Spanish-American War.

He has contributed largely to the engineering and scientific press of the country, and is the author of the article on electric traction in the Encylopædia Brittanica. He was twice elected president of the American Institute of Electrical Engineers, and is a member of the Mathematical Society of France, the Physical Society of France, honorary member of the Franklin Institute, member of the American Electrochemical Society, and a member of the Philosophical Society. At the International Electrical Congress held at the World's Fair in St. Louis, he was chairman of the Electric Railroad Section of the Congress.

Dr. Duncan is now consulting engineer for a number of important lighting and traction interests. He is a remarkable analyst, possessing a keen and brilliant faculty for arriving readily at the solution of the most intricate problems. His reports on a number of large propositions have attracted widespread attention and upon him has devolved the responsibility for the expenditure of tremendous sums of money.

Electric Vehicle Association of America.

On Tuesday evening, January 17, the regular monthly meeting of the Electric Vehicle Association of America will be held in the Engineering Societies Building, 29 West Thirty-ninth Street, New York City, at 8 o'clock.

"The Ironclad Exide Battery—The Latest Development in Electric Vehicle Batteries" is the title of an illustrated paper to be presented by Bruce Ford, of the Electric Storage Battery Company, Philadelphia, Pa.

Among those who will discuss the paper will be W. P. Kennedy, of the Studebaker Automobile Company; F. F. Sampson, of the New York Transportation Company, and others prominently identified with the electric-vehicle industry.

Thermal Conductivity and Magnetization.

The thermal conductivities of rods of iron and steel between 12 and 110 degrees centigrade have been shown to slightly decrease when they are magnetized, according to an author in *Nuovo Cimento*. The intensity of magnetization used was 1,500 C. G. S. units and the effect was greater in iron than steel. The magnetization was in the direction of the flow of heat, and could be reversed without changing effect.

Telephone Rates from the Plant Viewpoint.

Few people outside the engineering and construction departments of a public-service corporation supplying thousands of consumers in a territory of wide area and diversified interests realize the effect which a change in rates by the order of a state commission may produce upon the arrangement and utilization of the physical plant, and particularly upon the distributing system. In a paper recently presented before the Telephone Society of New England, I. O. Wright discussed the new rate schedules of the Boston telephone district from the plant point of view, throwing considerable light upon the organization and methods required to change the service of many thousands of subscribers without delay or confusion. The change in rates came about after a long investigation by the Massachusetts Highway Commission of the plant and traffic of the New England Telephone & Telegraph Company, and immediately after the company accepted the recommendations of the Commission for trial it became apparent that a large amount of work would be thrown upon the plant department on account of changes from multiparty to single and two-party service. Only one new feature in local plant practice was introduced, that being divided ringing, but this had never been given in any exchange in the entire Boston district, and it was necessary to place new equipment or make changes in existing apparatus or wiring in every one of more than 1,000 positions in fifty-one exchanges.

The exchange portion of this work was mainly handled at night in order not to interfere with traffic. A detailed study was made of the probable requirements for extensions and additions to permanent plant and equipment, with careful tabulation of the surplus apparatus available at different points. The routine forecasts of the company of the equipment necessary for 1911 had been made as usual in the summer, and the existence of provisional estimates greatly facilitated matters by enabling the company to hurry forward recommendations, estimates and requisitions for supplies, and to arrange delivery schedules with the manufacturers. On the strength of this work it was possible to tabulate for the information of the commercial department the percentage of preparedness in each exchange, with close estimates of the date when the exchange would be ready in all its parts for any load that present operations are likely to put upon it. The work was furthered by the preparation of maps indicating specific localities where ample facilities existed and where active canvassing for new subscribers and change orders might safely be made. Arrangements were also made for additional lateral cables and generally increased distribution facilities. The provision of an ample stock of cable and terminals, with the omission of certain features of ordinary routine, enabled the company to work more swiftly.

The problem of changing in a short time the service of about 100,000 subscribers, to provide for the prompt installation of services for the unusual number of new subscribers likely to be attracted by the favorable rates and by the publicity necessarily given to a matter so closely affecting the popular interests, without delaying the requirements of subscribers with respect to extensions of service, change of location and disconnections, was not one to be treated superficially. In a word, it meant increasing by several hundred per cent within a very limited time the productive output of an established organization. It was met by making a study of the capacity of the district office forces, wire chiefs, store rooms, district foremen and district accounting forces to handle an expansion of business, and it was found that with the addition of a suitable number of subordinate employees a load expansion of 1,000 per cent could be taken care of. It was necessary to add only a sufficient number of junior clerks in the district offices to keep up with the increased requirements in receiving, classifying, recording and distributing orders and looking up municipal and private-property permits; to provide additional equipment and to increase the test and record force in the wire-chief's divisions; to obtain an unsual reserve supply of outside and inside equipment and material, with the employment of additional stock-room labor at certain strategic points; and to multiply the capacity of the district forces for installation work by relieving them of heavy construction service and turning all of that class of operations over to an enlarged construction department, capable of meeting the larger field duties. Adequate field supervision of many new men unskilled in telphone work was accomplished largely by promotions within the company's organization, and it is suggestive that Mr. Wright attributes no small part of this successful administration to the co-operative educational influence of employees' organizations combined with the work of an examining board having an intimate connection with maximum salaries. The result of the thorough organization planned in relation to the necessary changes has been little short of remarkable in its non-interference with the service, its rapid connection of new customers to the system, prompt transfers of old subscribers to the new rate classifications, the retention of existing rates in cases where the subscriber desired no change and the re-adjustment of methods of charging for toll calls along with the new message and flat rates placed in service. That a corporate organization could thus be developed to meet such an emergency, rising to a maximum of over 800 completed changes in a single day, without extensive increases in its most expensive construction labor and supervision or unsual unit costs and delays goes a long way toward refuting the popular idea that large organizations are necessarily inefficient.

Minneapolis Electric Club Banquet.

The Minneapolis Electrical Club will give its annual banquet the evening of January 19 at West Hotel. Many of the 250 members are also members of the Minneapolis Electric Show Association which will open an exhibition January 26.

Toledo Section Meeting of the A. I. E. E.

At the monthly meeting of the Toledo Section of the American Institute of Electrical Engineers, held on January 6, Burton Nichols delivered an address on the subject, "Some Phases of Commercial Engineering Practice in the Automobile Industry."

Exports of Copper.

Exports of copper for the week ended January 5 were 7,192 tons. The amount exported since the first of the month was 4,460 tons, the corresponding figure for last year being 2,940 tons.

Exports of copper for the month of December were 31,526 tons, against 28,104 fons last year.

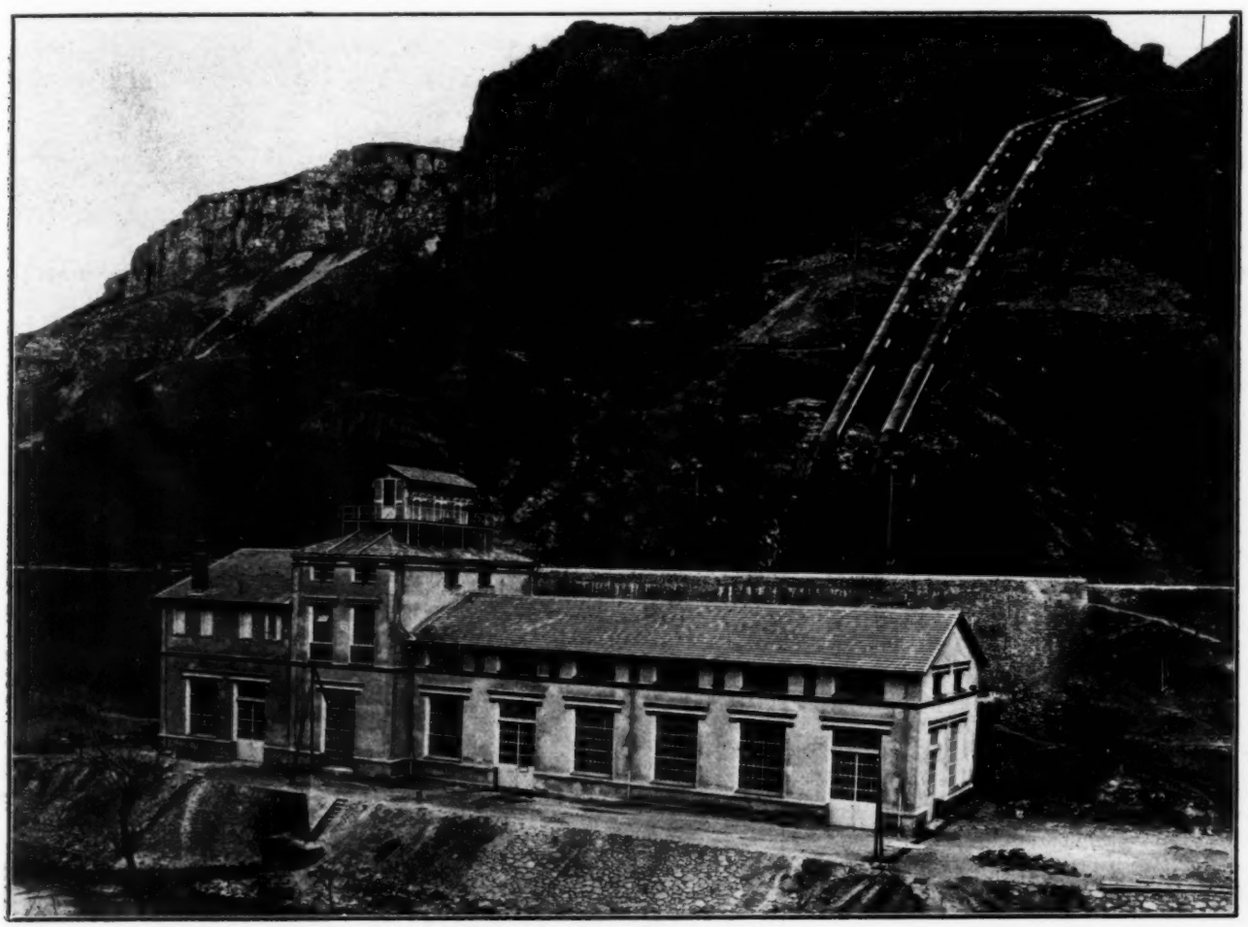
The Hydroelectric Plant at Madières.

Description of a Generating Plant on the Vis River in France.

BY C. L. DURAND.

One of the most recent hydroelectric plants to be installed in France is the turbine station which is located on the Vis River, an affluent of the Herault. It is situated in the Mediterranean coast region, and is designed to supply a large power network owned by the South Electric Company. The network is already considerably extended over the country lying near the Rhone River, taking in a number of large centers, such as Avignon and Montpellier, as well as smaller towns. Current is generated by the turbo-alternator groups at 3,000 volts, three-phase, and this is raised by transformers to 33,000 volts for a double power line running for thirty miles to a large substation lying at Sommières. The latter furnishes a reduced voltage of 13,500 volts for supplying the power network.

Referring briefly to the hydraulic work of the present plant, the dam is situated somewhat above the village of Naracelles, and lies normal to the course of the stream. At the dam there is a settling basin, into which the water passes through a grating seventy feet in length. The main flume starts from the basin and it has a total length of about six miles. In the open parts, the flume is cut in the rock of the mountain side and has a rectangular section. The outer side of the flume is formed by a masonry wall. The section of the canal is designed so as to use a maximum gradient of 0.05 per cent and to obtain a flow of 4.5 cubic yards per second. A good part of the construction work lay in the underground flume, and a number of tunnels were excavated in the solid rock for this purpose. The inside is lined simply with cement. On the whole course there are no less than seventeen tunnels, some of which exceed 1,300 feet in length. On the open parts of the flume precautions had to be taken to avoid material falling down the mountain side. Flat slabs of reinforced concrete were placed over the flume at the exposed parts in order to protect them. This is shown in the illustration on the next page.



THE HYDROELECTRIC PLANT AT MADIÈRES, FRANCE.

Where the flume ends above the village of Madières there is a somewhat unusual piece of work in the shape of

an underground water chamber. It is cut in the rock of the mountain which overhangs the turbine plant. As the mountain has a very steep slope in this locality, it was not possible to build an open-air basin of the usual kind, so that the work had to be carried out entirely underground. The basin has a capacity of 15,000 cubic yards and thus affords a valuable reserve supply for the turbine plant, giving the needed volume for taking care of the peak load of the station. For the basin there are used three galleries opening into a main gallery; from the latter point the penstocks make their start, and are fitted with the usual gratings and gates.

Two penstocks are built for the plant, each about four feet in diameter. The first section of penstock starts from the reservoir and lies underground, coming to an outlet stack thirty-three feet in height, which allows an overflow at the top, and the stacks serve to limit the pressure which is produced when the turbine inlet gates are closed. Reinforced concrete was used for building the stacks. For the rest of the way down to the turbine house steel plates are employed for the penstocks. Each of these has a capacity equal to the entire capacity of the turbine plant. The penstocks end in a common feed piping, which runs parallel to the station building, and from it are tapped the five pipes for the turbine groups. For the present plant the head of water is 353 feet.

The general appearance of the dynamo room will be observed in one of our engravings. Five turbine sets of 1,000 horsepower each are installed, and, owing to the present method of water storage, the plant is able to give its maximum output of 5,000 horsepower during three hours' consecutive run. It may appear that the size and number of the turbine sets which are installed in the Madières plant are much above what is needed for the output of the Vis River, especially during the summer period, when low water prevails, but it must be taken into account that the station is designed to supply a region in which most of the current is used for lighting and the peak load is considerable. This led to the installing of machines of suitable output to take care of this load.

The alternators are of the Alioth type; they are coupled direct to the turbines and give three-phase current at 3,000 volts and fifty cycles. Besides the main groups, there are two small turbine sets for the exciters. Each of these is designed so as to furnish the whole of the exciting current for the alternators and at the same time to give the lighting current for the station itself.

VIEW OF FLUME WINDING ALONG MOUNTAIN.

VIEW OF PROTECTED FLUME.

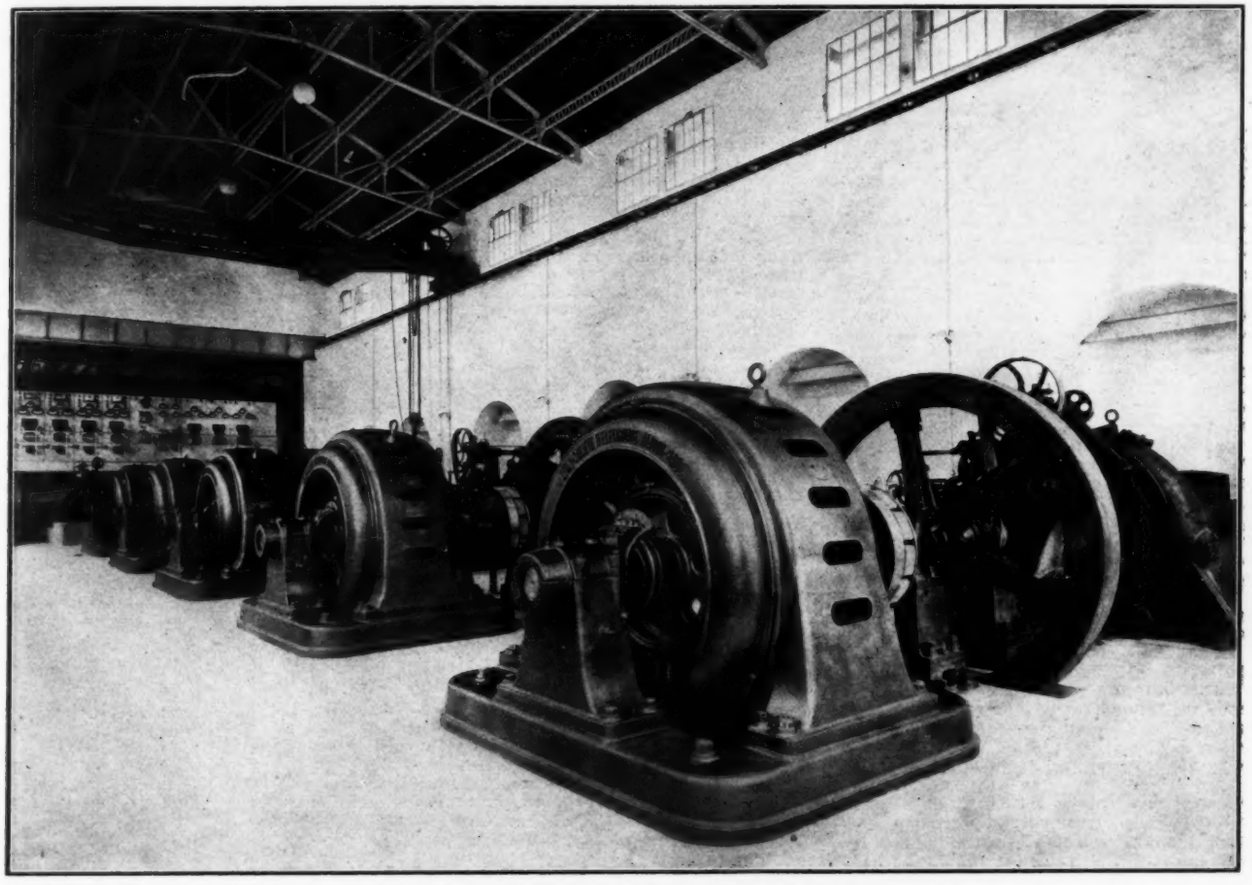
Upon a platform overlooking the generator room is installed the switchboard, and it carries all the apparatus for controlling and handling the station circuits. All the high-tension circuits and the apparatus which is directly connected thereto are placed below this platform in a separate space on the level of the station floor. The high-tension apparatus is mounted in reinforced concrete cells, which are kept well separated. Repair work on this part can thus be very well carried out without interfering with the operation of the plant. All five alternators feed on to a common set of busbars,

and these are laid out in the form of a continuous loop. At the coupling points of the alternator circuits there are sectioning switches so as to allow of making different combinations of circuits such as are required for the best working.

As to the transformers, on the 3,000-volt busbars are three circuits, each supplying a group of three Alioth single-phase transformers, star-connected. Each transformer is designed to give 450 kilovolt-amperes, so that the whole outfit comprises three groups of 1,350 kilovolt-amperes. The machine voltage of 3,000 volts is raised to 33,000 volts for the power lines. In order to compensate for drop in the lines there are several taps brought out of the transformer coils with connection plugs. The transformers are of the vertical-core type and are cooled by forced draft. The high-tension windings are insulated by a special dipping process, which adds to their strength, and they are divided into interchangeable coils. Space is left in the plant for a fourth group of transformers. Two motor-driven fans are installed for supplying the air blast. The 33,000-volt switchboard is placed in a space lying behind the 3,000-volt board upon the same platform, and the accessible part comprising the measuring and operating devices is kept well separated from the reinforced concrete cells in which are installed the 33,000-volt circuits and all the apparatus directly connected to the high-voltage lines.

From the turbine station are run two power lines in order to connect it with the substation at Sommières. Each of the power lines is thirty miles long and they are mounted on different sets of poles, running parallel to each other throughout the whole course and spaced fifty feet apart. The insulators were tested at 90,000 volts on a shop test. They are of the triple-petticoat porcelain type and fixed by galvanized iron brackets to the poles. All the poles are interconnected by two steel wires, which serve the double purpose of stiffening the line construction as a whole and also of allowing the whole pole system to be grounded. To this end ground plates of large size are distributed along the line and are connected to the wires. A telephone line is also run on the poles. The two power lines are of identical design and each one is designed for 3,000 kilowatts.

At Sommières is installed a substation which is used to reduce the line voltage from 33,000 to 13,500 volts, as this latter voltage is adopted as standard upon the power network belonging to the South Electric Company. At the point where the power lines enter the substation, there are placed automatic circuit-breakers for throwing off either of the lines in case of short-circuit. A bank of step-down transformers is mounted in the substation. It comprises eight Alioth transformers divided into two groups, so as to have three transformers in service and one as a standby for each group. They are of the same type as described above. A small charging set works with a storage battery in order to afford an independent lighting service for the premises in case all the current should be cut off.



MAIN GENERATING ROOM, MADIERES HYDROELECTRIC PLANT.

Chicago Telephone Report and Company's Reply.

The Sub-Committee of the Chicago City Council, which has been investigating the cost of supplying telephone service to the people of Chicago and the reasonableness of the charges made by the Chicago Telephone Company, has submitted its report. The report is signed by William J. Hagenah, the expert in charge of the investigation.

The report deals with the capitalization, investment, operating and maintenance charges, etc., of the Chicago Telephone Company. This company operates outside as well as inside of the city limits, and an attempt has been made to adjust all items of the finances so as to make them applicable to the plant within the city alone. The figures given refer to the year 1909.

The capitalization consists of $27,000,000 in stock and $5,000,000 in bonds. Over 262,000 telephones are connected to its exchanges; there are 69,666 miles of aerial cable; 62,985 miles of wire on poles, and 493,787 miles of wire underground (2,685 duct-miles). The annual gross receipts are $8,321,610. The cost of the plant, according to the company's construction account, is $20,778,686. Real estate holdings of $2,446,157 bring the total investment up to $23,224,843. This is reduced in the report, by adjustments of the construction account, and setting aside part of the buildings as used for toll service, to $19,577,501. Adding to this the amounts for furniture, tools, teams, working capital and reserve credit balances, a total $22,098,953 is obtained. This represents the book cost. The subject of depreciation is then discussed, and it is shown that the company has made no systematic provisions for a depreciation fund.

Another method of arriving at the value of the investment is by appraisal. The inventory of the company was accepted for the larger part of the property. According to the company's valuation of the property, a total of $23,406,126 is obtained. According to the unit costs adopted in the report, the cost of replacement of the property is $22,115,764. The difference is mainly due to allowances for appreciation in the value of real estate, and lower unit costs in the items of conduit and subscribers' instruments. The present value of the plant is considered less than this on account of depreciation. If a proper depreciation reserve had been set aside each year out of the gross earnings, this would constitute a fund insuring the replacement of worn-out material. In the absence of such a fund, it is assumed that the value of the plant has depreciated. The average life of the entire plant is estimated at fifteen years, the various items ranging from fifty years for buildings down to five years for furniture. From this, the present value of the depreciable part (excluding land, working capital, stores, tools and teams) is computed to be 77.5 per cent of its cost value. The present value of the total plant is thereby fixed at $19,053,169, which it is stated should serve as the basis for the adjustment of rates.

The operating expenses are then considered and the rental of $357,413 paid to the American Bell Telephone Company for the use of instruments is considered exorbitant; $203,584 is deemed ample for the service rendered. A depreciation charge of $921,759 is added to the actual operating expenses, giving a total of $5,747,330, which is considered proper. The company's total for 1909 was $6,095,765. The net revenues should be, according to the report, $1,953,583. Eight per cent is considered a reasonable return on the valuation of the property. This amounts to $1,524,254, leaving a surplus of $429,329, or about two per cent. If the present value of the plant is taken as the book cost, the income would still yield eight per cent. It is, therefore, concluded that the present rates yield sufficient revenue, and any increase is unwarranted. A reduction equivalent to the two-per-cent surplus might even be made, but a distribution of operating expenses would be necessary to determine which class of service should receive the reduction.

In reply to this report, the president of the Chicago Telephone Company, B. E. Sunny, sent a letter on January 5 to the Committee, in which it is stated that the Company claims an investment of $23,285,461.

The construction and real estate accounts of the company were audited and approved by the City Auditor in 1906, by a commission in 1907, and by city representatives in 1910. He disagrees with the statements in the report as to cost of duplication and as to condition of plant with regard to depreciation. The actual cost of the plant should form the basis for fixing rates, but the present plant could not be reproduced for less than $5,000,000 in excess of cost. The investment per station is only $100, while the average of 26 companies in the United States is $147. The theory of depreciation applied is new, and the company should not be penalized for not having complied with it in the past. Correct ideas of depreciation in telephone property could not be formulated until very recent times. It has not been customary in the past to set aside depreciation reserves, and it is not done now by the water works or other City departments or by such large electric companies as the General Electric Company and the Western Electric Company. The Commonwealth Edison Company, with an investment of $64,000,000, has a depreciation reserve of only $2,700,000. The railroads of the country, notwithstanding the supervision of the Interstate Commerce Commission, have no uniform practice in dealing with depreciation. Fifty per cent of the present plant has been added within four years, and the depreciation has been small, and is more than balanced by the increase in the present value of the plant over its cost.

The agreement with the American Bell Telephone Company was approved by the 1907 commission; it is a binding contract and is considered by the officers to be advantageous. It should be restored to the list of proper expenses.

The report does not give the company credit for taxes or percentage of gross receipts paid to the City in the proper sum, there being an error of $300,000. This wipes out over two-thirds of the alleged surplus.

The City has reserved the right to compel the telephone company to install station meters, and this seems to be contemplated. The additional investment required will probably be $1,000,000 and the operating expenses $300,000. These items should be considered in fixing future rates.

In the event of the construction of subways, the telephone company is required to remove its conduits, and pay rental for the use of the new ones included in the subway. This cost is estimated at $120,000 a year for five years. Regulation of rates should only accompany a franchise giving a monopoly, yet the Committee refused to sanction the consolidation of the two telephone companies, and competition is now certain. With competition there should be no regulation of rates. This competition will probably reduce the net income of the company by $700,000.

Chicago Railway Rotary-Converter Stations.

At a meeting of Armour Institute Branch of the American Institute of Electrical Engineers, held on the evening of January 5 at Armour Institute, Chicago, Joseph H. Jacobson, engineer inspector of the Board of Supervising Engineers, Chicago Traction, made an address on "Railway Rotary-Converter Stations."

Mr. Jacobson based his remarks particularly on the practice prevailing in the numerous Chicago street-railway substations. He called attention to the favorable contract by which the Chicago traction companies have been enabled to secure the bulk of their power by purchase from the Commonwealth Edison Company and as the result of which fourteen railway substations have been erected at relatively low cost.

Thus the Chicago Railways Company has six substations with ultimate rated capacity as follows: Van Buren Street, 12,000 kilowatts; La Salle and Illinois Streets, 10,000; Milwaukee Avenue, 6,000; Lill Avenue, 6,000; Grand and Fortieth Avenues, 6,000; Twenty-fifth and Leavitt Streets, 6,000. The Company also operates four power houses as follows: Western Avenue, 8,800 kilowatts; California Avenue, 5,500; Hobbie Street, 3,900; Edgewater, 1,815; the aggregate capacity of these four stations is 20,015 kilowatts against 46,000 kilowatts in the six substations.

The Chicago City Railway Company has five substations with ultimate rating as follows: Twentieth and Dearborn Streets, 12,000 kilowatts; Sixty-third Street and Wentworth Avenue, 12,000; Forty-second Street and Wabash Avenue, 14,000; Forty-eighth and Honore Streets, 10,000; Plymouth Court, rotaries 2,400, storage battery 2,240. The total capacity in these five substations is thus seen to be 52,640 kilowatts.

The Calumet & South Chicago system has three substations, as follows: Grand Crossing, 2,000 kilowatts; South Chicago, 3,000; Roseland, 2,000. The rotary equipment in these three substations is made up of seven 1,000-kilowatt machines receiving through transformers 20,000-volt, three-phase, twenty-five-cycle current from underground cables.

CHICAGO ELECTRICAL SHOW.

SIXTH ANNUAL EXHIBITION, AT THE COLISEUM, JANUARY 7-21.

The sixth annual electrical show of the Chicago Electrical Trades Exposition Company was opened on January 7, at the Coliseum with every foot of available space occupied and a large and enthusiastic attendance on hand. The decorative scheme this year is said by many to surpass anything of the kind ever before disclosed at a trade show.

Unlike any previous decorative scheme for the electrical shows, which in the past have been scenes of dazzling light, the setting, this year, is a cloud-flecked noonday sky. Hidden in the pale green and white bunting which is draped around this great expanse of sky are a number of indirect lighting units which illuminate the ceiling decorations producing a realistic effect. Suspended from this drapery, at regular intervals around the border are art-glass pendants enclosing Mazda lamps, the whole throwing a sufficient, but subdued light over the entire auditorium.

Each booth is divided by ornamental corner posts, each of which supports an Alba glass globe enclosing a 100-watt Mazda lamp. This lighting is augmented by frosted-globe Mazda lamps studded in decorated lattice work extending partly over each booth. Surrounding the great hall, around the balcony rail, is a frieze, bearing escutcheons, spaced on twenty-two-foot centers, made up of imitation art glass and illuminated by incandescent lamps.

The officers of the Electrical Trade Exposition Company, to whom credit is due for the remarkable success of this show are: President, Samuel Insull; first vice-president, Ellsworth B. Overshiner; second vice-president, Louis A. Ferguson; secretary, Stewart Spaulding; manager, Homer E. Niesz. The directors are Samuel Insull, G. H. Atkin, Stewart Spaulding, Ellsworth B. Overshiner; George B. Foster, W. W. Low, Louis A. Ferguson, F. V. Bennis and Ed J. Mock.

Much interest is shown this year in the Government exhibit which occupies the entire Coliseum annex. In this exhibit there are shown models of modern war vessels, photographs of the engineering features of prominent governmental projects, samples of work carried on at the Bureau of Printing and Engraving at Washington, a number of old muskets and the newer rifle as used in the service, rapid-fire guns and other interesting exhibits.

The Government has also installed in its exhibit space a regulation wireless telegraph station as is installed

GENERAL VIEW OF INTERIOR OF COLISEUM DURING THE CHICAGO ELECTRICAL SHOW.

on ships in the navy. This station is connected to an antenna on the Coliseum roof and messages are received and transmitted from neighboring stations.

As in former years the management has spared no expense in providing for the entertainment of the visitors. Afternoon and evening band concerts are given by John C. Weber and his "Prize Band of America," assisted by Miss Blanche Berndt-Mehaffey, soprano.

A feature of the exposition this year is a guessing contest which is being conducted and for which a number of elaborate presents have been donated. In the center of the hall there is located a huge column of electrical wire and each spectator is allowed to estimate the number of feet of wire it contains, proper statistics of course being given. The prizes offered include a Woods electric automobile, valued at $2,650, a Tel-Electric piano player, a Thor electric washing machine, Cutler-Hammer water heater, Electric Shop portable lamp, Westinghouse fan, Cadillac electric stove and toaster, and Simplex toaster.

By far the most extensive and comprehensive exhibit is that of the Commonwealth Edison Company

At the north end of the Coliseum, balancing the big government exhibit at the south, the Commonwealth Edison Company has a unique and attractive model street called Commonwealth Avenue. This street is brilliantly illuminated with the type of ornamental street lamp post for incandescent lamps employed for the new lighting along Lincoln Avenue, near Belmont Avenue, Chicago.

The north side of this street is occupied by six stores, in each of which there is a distinctive method of illumination demonstrated. The sidewalk in front of them is slightly raised above the level of the Coliseum floor, giving a realistic effect, and the show windows of all the stores are beautifully trimmed and illuminated.

Beginning at the west end, the first is a model grocery and meat market. In the show windows are displayed an entrancing assortment of fruits and vegetables. The next store contains household appliances using electric energy for various purposes, such as vacuum cleaners, washing machines and wringers, ice cream freezers, knife cleaning and sharpening machines, silver polishers, dish washing machines, and a "Federal" electric kitchen table equipped with a motor and countershafting, operating a great variety of devices for paring, coring, grinding, beating and mixing, etc., all in the most convenient and compact arrangement. A display of electric cooking utensils completes this installation. Next to this comes the Lamp Shop, a vision of light and color containing a beautiful arrangement of ornamental electric lamps for every conceivable purpose, from the heavy standard six feet high, to the little piano lamp and the dainty little lamp for a lady's writing desk. There are also a number of exquisite pendent domes illustrating the latest ideas in art lamp glassware. Adjoining this is another most attractive store, beautifully stocked with the finest growing and cut flowers, flowering plants and shrubs, ferns and palms. Of special interest to the ladies is the linen and lace display in the next compartment. Another in this famous row of model stores is devoted to men's furnishings. Here the most fashionable and attractive in this line is displayed, and in arrangement, illuminative features, etc., compares favorably with the previously described exhibit.

EXTERIOR OF COLISEUM.

One of the principal objects of this exhibit is to illustrate and contrast good methods of electric illumination of stores and show windows.

Addressograph Company, Chicago, Ill., is exhibiting a number of its electrically- operated machines for addressing envelopes, postals, etc.

Allis-Chalmers Company, Milwaukee, Wis., is exhibiting a full line of its electrical products. Of particular interest are the lighting transformers, ranging in size from seven and one-half kilowatts to twenty kilowatts capacity; a number of alternating and direct-current motors and portable and stationary air compressors. The stationary air compressor outfit is shown in operation. At different points in the exhibit space there are hollow flag staffs to which are attached small silk flags. These hollow flag staffs are connected to the air tank in the compressor outfit through an electrically operated valve and, by means of an extra contact on the governor of the air compressor, the air is intermittently applied to the flags through perforations in the flag staff. The effect is that, during the time when the compressor is not operating, the flags are blown in a horizontal position and, as soon as the air pressure in the system is reduced to a predetermined point, the governor automatically throws the electrically operated air compressor in circuit and at the same time cuts off the air from the flags. The compressor then continues to operate until the air is increased to the proper pressure, at which point the governor throws out the compressor and again applies the air to the flags. The following representatives are in attendance: S. R. Kerr, A. D. Waring, J W. Gardner, C. M. Howe, A. W. Burns, James Ashworth, W. M. S. Miller and C. Jurgens.

American Ozone Company, Niagara Falls, N. Y., has on exhibition one of its ozone machines for sterilizing water. This is shown attached to a water-supply system as regularly installed in dwellings and ozonized water is then compared with the city water. There is also shown a clarifying filter which is designed for use in connection with the ozonizer when turbid waters are treated. E. C. Spurge and S. F. Butler are in attendance.

American School of Correspondence, Chicago, Ill., is exhibiting its electrical and other textbooks and is distributing literature bearing on the various courses taught. A corps of representatives are explaining the value of a technical education and describing the benefits to be derived from a course of study.

American Steel & Wire Company, Chicago, Ill., is making a comprehensive display of all of its products interesting to the electrical industry. On attractive sample boards are exhibited samples of magnet wire, rubber-covered wire, trolley wire, telephone wire, lamp cord, lead-enclosed cables, paper-covered cables, rail bonds, etc.

An interesting feature of this exhibit is the span of telegraph wires between two standard telegraph poles located at each end of the exhibit space. This stretch of line is equipped with all equipment used in actual service. B. H. Ryder is in charge of the exhibit.

American Telegraph Typewriter Company, New York, N. Y., is exhibiting the American telegraph typewriter. This machine sends messages over telegraph or telephone wires and prints them at both sending and receiving stations. The Company is sending and receiving messages from the Coliseum and its office in the Rector Building, Chicago, for both the Postal and Western Union. The lines of the Chicago Telephone furnish the connections from the Rector Building and the Coliseum. The Company is represented by Lorimer & Company, Chicago.

American Telephone & Telegraph Company is exhibiting jointly with the Chicago Telephone Company. The Company has installed booths and operates a long distance pay station at the exposition during the day, and in the evening uses these booths

VIEW OF GOVERNMENT EXHIBIT.

to demonstrate its service to the larger cities. Maurice J. Kenyon, special agent from the Chicago office is in charge.

Anderson Carriage Company, Detroit, Mich., is exhibiting its 1911 Model Detroit electric pleasure vehicles. The special features of these cars is the direct shaft drive from pinion of motor to gears of rear axle. The exhibit is in charge of Frank E. Price.

Apex Appliance Company, Chicago, Ill., is exhibiting a number of its all-metal washing machines. These includes both electric and handpower machines. The exhibit is in charge of C. W. Swanson.

Armstrong Company, G. W., Chicago, Ill., is exhibiting a complete line of electrical novelties bearing the "Acco" brand. These comprise electric flash lights, from the miniature size to sizes large enough for commercial use; novelty electric stick pins, Christmas tree ornaments, Christmas tree lighting sets, etc. These novelties are all operated by the Green Seal battery which is also exhibited in a variety of sizes. This battery is said to have extremely long life. The Company is also exhibiting the Acco lamp hanger and a number of Excello flaming arc lamps, including the new long-burning flaming arc lamp which is being exhibited for the first time. Those in attendance include George W. Armstrong, H. Caird, R. L. Thayer and R. K. Fast.

Automatic Enunciator Company, Chicago, Ill., is carrying on a working demonstration of its loud-speaking telephone. This apparatus is designed for railway stations, wholesale houses, etc., and at the show is given tests under the most severe conditions. The Company is represented by Louis Cole, Percy Hinkley and F. B. Ijams.

Babcock Electric Carriage Company, Buffalo, N. Y., is exhibiting two of its popular model electric vehicles. One, a coupe, is equipped with a thirty-six-cell lead battery and the roadster type exhibited is equipped with a forty-two-cell lead battery. The Company is represented by J. F. Fisher.

Birtman Electric Company, Chicago, Ill., is exhibiting and demonstrating its line of "Bee" machines, comprising suction cleaners, pedestal vibrators, portable vibrators, pedestal hair dryers, portable hair dryers, Radio or beauty lamps. The exhibit is in charge of A. H. Apfel, F. A. English, A. J. Saunders and H. R. Butz.

Cadillac Electric Manufacturing Company, Chicago, Ill., is exhibiting a complete line of electrical heating and cooking devices, comprising toasters, percolaters, corn poppers, griddles, stoves, etc.

Chicago Fuse Manufacturing Company, Chicago, is exhibiting elaborate sample boards on which are shown conduit outlet boxes, sectional switch boxes, inclosed fuses, inclosed fuse blocks, fuse wire and fuse links; all sold under the trade name "Union." Those in attendance are W. W. Merrill, Arthur S. Merrill, Walter D. Dana, George C. Reid, C. T. McDonald, G. E. Harland, Joseph Pearson and Felix Trautmann.

Chicago Pneumatic Tool Company, Chicago, Ill., is exhibiting a complete line of electric drills, grinders, hoists, etc., also a line of pneumatic tools. The Company is represented by Messrs. Coates, Conrow, Schumacher, Jahn and Gilliland.

Chicago Telephone Company is exhibiting telephone exchange apparatus as it appears in actual operation. The largest size multiple switchboard for subscribers' lines now built by the Western Electric Company is installed in two sections, employing six operators, with supervisors, chief operator, etc., just as in the Company's exchange offices. The lighting of miniature call-lamps, the answering of calls by operators and the completing of connections in the multiple gives a practical demonstration of telephone exchange work. A novelty this year is the switchboard and the operators on a slowly revolving platform enabling the visitors to view the operation of the switchboard from the aisles at the west, south and east of the exhibit. In addition to all this, from booths located in the telephone sections there is given a practical demonstration of long-distance toll service throughout the country and free service is rendered to many points outside of the city. The Chicago Telephone Company is represented by A. M. Ramsay, contract agent, and N. Anderson, traffic chief, and O. W. Stitt in charge of demonstrators.

Cosmopolitan Electric Company, Chicago, Ill., is conducting an interesting exhibit showing the application of central-station power to industrial operations. The display comprises a motor-driven automatic lathe which is shown in operation turning out brass souvenirs; motor-driven air compressors, forge blowers, etc. Also a lifting magnet of the Electric Controller & Manufacturing Company's manufacture, which is installed on a platform and shown in operation lifting pig iron, etc. A number of photographs of motor installation are also shown. The company is represented by Homer E. Niesz and J. H. Delany.

Crane Company, Chicago, Ill., is exhibiting Crane cast-steel motor-operated gate valves with near and remote control; Crane Ferrosteel emergency valves with electric release; operating exhibit of Cranetilt steam traps, demonstrating the most economical method of handling condensation under any and all conditions; Cranetilt direct-return traps, and one non-return trap, with section removed showing scarcity of interior mechanism; twelve-inch No. 9 E Crane cast-steel gate valves fitted with by-pass; Crane Ferrosteel stop-check valve with section removed, showing interior operating parts; Cranelap and welded pipe joints and numerous small valves for high superheated lines. F. C. Sabin and J. A. Minwegan are in charge of the exhibit.

Cutler-Hammer Manufacturing Company, Milwaukee, Wis., is exhibiting in addition to a full and complete line of electric irons, stoves, curling iron heaters, radiators, chafing dishes, coffee percolators, teakettles, etc., for the first time a line of adjustable disc stoves, wherein the heat contained in the stove can be regulated to any degree desired, the same as with a gas burner or alcohol lamp; also for the first time in this city a line of carbon instantaneous water heaters, comprising bath, lavatory, bar, therapeutic, and kitchen tank heaters from which a continuous flow of hot water can be obtained in from fifteen to twenty seconds. The company is also exhibiting a line of instantaneous portable water heaters for use in the home, on the buffet or sideboard. The exhibit is in charge of George B. Katzenstein.

Duntley Manufacturing Company, Chicago, Ill., is displaying its complete line of electrically-operated vacuum cleaners, of both the portable and stationary types, also air washers, air purifiers, manually operated cleaners, etc. Demonstrations are carried on continuously, showing the varied uses of these machines. In addition, this company is exhibiting an automatic press-feeder. W. W. Bishop is in charge of the exhibit.

Driver-Harris Wire Company, Harrison, N. J., is exhibiting its line of resistance alloys in the form of round and flat wire. There is displayed "Nichrome" wire glowing at working temperature in the open air to demonstrate the non-oxidizable properties and efficiency for all types of heater work and other applications requiring a wire for service under extreme conditions. "Climax," a nickel steel alloy; "Advance," a copper nickel alloy, and "Monel" metal are among the other alloys shown. The exhibition is

in charge of Elwood Duble, Jr., western sales manager, and Harry G. Harrington, chief of the engineering staff of the company.

Domestic Equipment Company, Chicago, Ill., is exhibiting several types of Domestic washing machines. Of especial interest are the Domestic electric washer and wringer and the Oscillator, a manually operated washer. Both of these machines are shown in operation. The Company is represented by David J. Kennedy, Richard J. Killick, S. M. St. Clair and Miss Howard.

J. R. Deane & Company, Chicago, Ill., is exhibiting one seven and one-half horsepower Peerless interpole motor, late type colonial oscillating fans, Independent Electric Manufacturing Company's direct-current motor starters and speed regulators, monophase starter with no-voltage release, three-phase starter for slip-ring motor. The following representatives are in attendance: J. R. Deane, F. L. Merrill, J. B. Estabrook, and Wm. H. Gaulke.

Edison Storage Battery Company, Orange, N. J., is exhibiting all of the various types of cells manufactured by the Company. There is also shown batteries assembled for various purposes, such as electric vehicle propulsion, lighting of railway cars, house lighting batteries and ignition sets; also all of the cell parts, showing the process of construction. C. B. Frayer is in charge of this exhibit.

Electrical Testing Laboratories, New York, N. Y., is this year exhibiting some of its methods of testing paper, embracing chemical and mechanical examinations for determination of suitability for all classes of use. Various devices are shown for obtaining the tensile strength, bursting strength, thickness and folding endurance of paper. In addition lantern projections of paper fibre as viewed under the microscope are shown, together with the methods of preparing samples for the various tests. The exhibit will prove of interest to all engaged in the manufacture and especially to those interested in the purchase of paper on an economical and scientific basis.

Electric Storage Battery Company, Philadelphia, Pa., is exhibiting its various types of storage battery, including the "Chloride Accumulator," the "Exide" and "Tudor" types. Among the novelties is the "Iron-Exide" which has recently brought out for use in electric vehicles. The Company is also showing the apparatus for farm lighting plants and batteries for railway car lighting and signal work. The plates, such as are used in the large installations for the Commonwealth Edison Company and the Elevated Railroads in Chicago, are shown. The Company is represented by Godfrey H. Atkin, T. Milton, T. A. Cressey, R. I. Baird, J. N. Rosholt, P. G. Downton and H. M. Beck.

Empire Vacuum Company, New York, N. Y., is exhibiting its complete line of portable cleaners and accessories. The feature of these vacuum cleaners is the steel dirt receptacle which prevents dust and dirt from leaving the machine. The efficiency of this receptacle is demonstrated under actual working conditions. The exhibit is in charge of C. Q. Adams and P. J. Whiteside.

Everson, C. G. & Company, Chicago, Ill., is exhibiting a complete line of novelty portable electric lamps, also a full line of water filters and coolers. R. B. Everson is in charge of the exhibit.

Excello Arc Lamp Company, New York, N. Y., is exhibting a number of its flaming arc lamps. Of particular interest is the new long-burning axis-type flaming arc lamp which the company has just perfected and which is claimed to burn seventy hours on one trim. There is also shown a new globe for its flaming arc lamps, which may be installed on any of its types and which is said to increase the life from seventeen hours to forty hours. George W. Armstrong and H. Caird are in attendance.

Farrington Automobile Company, Chicago, Ill., is exhibiting an electric pleasure vehicle and a chassis of a coupé, showing the construction and operation of the car.

Federal Electric Company, Chicago, Ill., has on exhibition a complete line of electric signs, using both carbon and tungsten-filament lamps, tungsten flasher signs, "Adlite" window lighting devices, the Federal vacuum cleaner, tungsten fixtures and clusters, Federal shaving mirrors and portable lamps and Willis meters. An interesting feature of this exhibit is the "automatic" kitchen cabinet, which consists of a motor-driven coffee grinder, meat chopper, dough mixed, flour sifter, etc., all mounted in a model cabinet. The exhibit is in charge of F. G. Martin.

Flexlume Sign Company, Buffalo, N. Y., is showing complete signs in raised prismatic letters in sizes from eight to twenty-four inches. W. R. Wiley and D. F. Wiley are in charge of the exhibit.

Fort Wayne Electric Works, Ft. Wayne, Ind., is featuring in its exhibit its motor-driven rock drills, these being shown in operation, also a complete line of fractional horsepower motors which are shown in exploded form with all the segregated parts arranged and mounted on boards. This shows in detail the construction of the motors. This Company is also exhibiting its eight-inch alternating-current and direct-current fan motors which are novel and unique as far as the type of construction is concerned. Also a complete regulator, transformer and switchboard for incandescent and tungsten series operation, besides a complete line of meters, bell ringing transformers, toy transformers and numerous other supplies. One of the transformers is in such form that it can easily be taken apart and inspected.

General Electric Company is exhibiting a full line of electric lamps, including both arc and incandescent types. The exhibit of rheostats includes many interesting designs. The drum controller, especially designed for machine tool work, has the field controlling resistance cut in and out of circuit by fingers similar to the fingers which perform the same service with regard to the armature resistance. The CR-162 controller represents the type in which armature-starting and field-regulating resistances are combined in one and the same box, thus dispensing with the use of two rheostats for a variable-speed motor. There are also exhibited a dial type controller for the single phase RI motor, a dial type controller for direct-current motors, a motor-starting rheostat and a motor-starting panel. The printing press controller comprises armature and field regulating resistances, overload and no-voltage release coils, dynamic brake and push button stop and jog from a single push button. The CR-225 pressure governor is used with a self-starting rheostat to maintain a predetermined air or water pressure. CR-225 D. P. contactor panel is used for controlling small motors from remote points or as an automatic starting rheostat in connection with a float switch or pressure governor for maintaining air or water pressure or fluid level. The display of meters includes recording and indicating steam and air flow meters and electrical indicating and recording meters. The CP-28 air compressor is an improved design in which all the working parts are perfectly accessible. All bearings are automatically lubricated. This compressor is now finding application in automobile garages for inflating tires, cleaning up autos, etc. It is shown in operation. Due to the peculiar quality of the alloy, Calorite, which is used by the General Electric Company as a heating element, it was possible to develope the domestic range which is exhibited. With this range cooking can be done as quickly as with gas or coal. Many other heating and cooking devices are on exhibition, including coffee percolators, chafing dishes, toasters, etc. A complete line of small motors is exhibited. A complete line of fan motors is also being exhibited.

Hoskins Manufacturing Company, Detroit, has on exhibition a number of its electric furnaces, including wire-wound resistance type multiple furnaces, for laboratory purposes, carbon-resistance type multiple furnace for treating steel, and several small crucible furnaces, a number of which are shown in operation. There is also shown its electric hot plates of different forms, sizes and for different uses, in connection with a variety of laboratory work, its electric pyrometers for determining high temperatures by means of thermo-electric currents, and also the Hoskins soldering irons and toasters. The company is represented by Ralph H. Badger, W. V. Young and C. F. Busse.

Hughes Electric Heating Company, Chicago, is exhibiting a complete line of electric ranges and stoves. Many of these resemble the gas range in appearance and many are of unique design. The Company is being represented by George A. Hughes and a corps of assistants.

Hurley Machine Company, Chicago, Ill., is exhibiting a complete line of the Thor electric laundry machines for the home. Also one of its Enamel machines that are now being placed on the market. Those in attendance representing the Company are W. J. Conlon, S. N. Cotterman, W. T. Haynie, J. Erickson, Neil C. Hurley, W. A. Murfey, E. J. Riedy, F. V. Widger and A. E. Merrill.

Hamler-Eddy Smoke Recorder Company, Chicago, Ill., is exhibiting four of its automatic smoke recorders. One of these machines is coupled to the stack of the Coliseum and indicates and records the amount of smoke coming therefrom. The exhibit is in charge of R. L. Eddy and a number of assistants.

Houston Manufacturing Company, Rockford, Ill., is demonstrating two sizes of its stationary vacuum cleaners, in operation. The exhibit is in charge of F. K. Houston, who is assisted by a large number of salesmen.

Illinois Appliance Company, Chicago, Ill., is exhibiting the adaptable lamp changer, the Bendyke vibrator and the Waage line of electric soldering tools. A number of interesting demonstrations are being given with the lamp changer. J. G. White and H. H. Woods are in attendance.

Ideal Electric Company, Chicago, Ill., is exhibiting the Ideal electric brougham. This car is equipped with forty cells. Those in attendance include Bruce Borland, E. W. Ryerson, Mark S. Willing, V. B. Grannis, C. H. Adams, Jr., C. B. Borland and others.

International Correspondence Schools, Scranton, Pa., maintains an educational exhibit, advertising its schools in a general way and a great many of the courses which are taught, putting particular emphasis on the electrical engineering department. There is also displayed lesson papers and drawings gathered from successful students in this immediate locality. A feature of the exhibit is an electrical contrivance, representing two large globes showing the number of students enrolled with the schools in every civilized country of the world. These globes are surrounded at the equator by a miniature railroad track upon which is a train of cars and locomotive running, same propelled by electricity.

Janette Manufacturing Company, Chicago, Ill., is exhibiting electric air compressors for saloon and garage purposes and automatic pressure regulators. Those in attendance are J. H. Silverstone, A. Janette, A. G. Banner and E. Silverstone.

Judd Laundry Machine Company, Chicago, Ill, has on exhibition its line of electric washing machines. These machines, which have no interior mechanism, such as paddles, pegs, etc., are shown in operation washing clothes. H. S. Judd is in charge of this exhibit, assisted by W. E. Starr, M. Walden and others.

Kratz, A. W., Chicago, Ill., has on exhibition several "1900" electric washing and wringing machines, which are shown working. The exhibit is in charge of A. W. Kratz.

Keller Manufacturing Company, Philadelphia, Pa., is exhibiting a complete line of its electric vacuum cleaners. These include the Santo portable, the Keller-Santo and the Santo duplex stationary vacuum cleaner. All of the machines are given severe tests, by the demonstrators. The Company is represented by Messrs. Nyberg, Hazard, Thiele, North, Ballou, Scott and Bates.

Kimble Electric Company, Chicago, Ill., is exhibiting its line of variable-speed, single-phase motors, from one-eighth to one-half horsepower. This includes a ventilating fan, forge blower, and a motor operating a printing press. In addition to this there is a line of polyphase motors, both constant speed and variable speed motors with controllers. These are made in sizes from one-fourth to ten horsepower. The polyphase variable speed motors are phase wound and of the slip-ring type. Controllers are of the the drum type and admit of eight speeds forward and four reverse. The exhibit is in charge of the following: A. Kimble, Jas. K. Bass, R. P. Warner, G. L. Holzheimer, H. A. Seaton, Roy O. Gilburg, Raymond T. High and Carl L. Healy.

Kinetic Engineering Company, Philadelphia, Pa., is exhibiting two Kinetic electric organ blowers. This machine is an especially designed centrifugal fan that is rapidly taking the place of the old fashioned water motor for blowing pipe organs. It consists of several fans mounted on a shaft, each fan handling the air in turn and raising the pressure step by step to that required by the organ. The exhibit is in charge of E. N. Johnson, J. G. Bierck and W. W. Ricker.

Macbeth-Evans Glass Company, Pittsburg, Pa., has a very attractive exhibit of glassware, comprising Alba reflectors, Bornique art glass shade, portable lamps and a complete line of Macbeth goods. The decorations of this booth comprise structural Alba glass in cylindrical form. The exhibit is in charge of A. C. Kay.

Machado & Roller, New York, N. Y., is exhibiting specimens of the complete Roller-Smith line including portable and switchboard volt, ampere and wattmeters for direct and alternating current; ohmmeters, testing sets, fault spotters and circuit-breakers; also a full line of the products of the Columbia Meter Company comprising the standard commutator service-type meters for direct current, the unique shunted astatic switchboard meters which are the only ones on the market which can be supplied for three-wire service, the Columbia high-torque induction meter of the service type and the similar meters for switchboard use. H. I. Shire and W. H. Sinks are in attendance.

Manhattan Electrical Supply Company, Chicago, Ill., is exhibiting a complete line of goods of its own manufacture consisting of electrical heating and cooking utensils, a display of the complete line of dry batteries, consisting of the Red Seal, Hi-Up, Blue Seal and improved Mesco, experimental wireless telegraph outfits, telegraph instruments, electric auto horn, medical apparatus, etc. The exhibit is under the direction of Clarke Methot, assisted by A. Holland, Oscar E. Fuchs and W. Haeger.

Mail-O-Meter Company, Detroit, Mich., is exhibiting one of its mailometers, a machine which in addition to stamping and sealing letters, registers the number of stamps used. The machine is motor operated and is shown working. E. B. Terry and James S. Brown are in attendance.

McCrum-Howell Company, Chicago, Ill., is exhibiting its "Richmond" vacuum cleaning machines of the stationary and portable types. Two of the most popular sizes of stationary machines are shown in operation—the one-horsepower, rotary pump type and the two-horsepower piston pump type. The former is designed especially for service in residences and other small buildings. The vacuum producer is a positive, rotary pump and is direct connected to a one horsepower electric motor. The "Richmond" suction cleaner (portable) is also shown in operation and the direct action and extreme simplicity of this machine makes it an object of great interest. The motor is direct-connected to the suction fan and this fan is located directly above the cleaning nozzle. Another feature is the light weight of the machine. In order to give the vacuum cleaning machines the proper setting and show them actually at work cleaning rugs, upholstered furniture, draperies, etc., the McCrum-Howell booth is artistically decorated to suggest a home interior. F. C. Allen is in charge of the exhibit.

Millar Electric Company, Chicago, Ill., is displaying a complete line of electric heating specialties. Of especial interest is the electrical flatiron exhibited which is double pointed and which has the connecting plug on the side of the iron away from the operator. This construction is said to be meeting with favor. The Company is represented by R. M. Millar, Francis Granger and R. L. Tobin.

Minerallac Electric Company, Chicago, Ill., is exhibiting its Chicago printing attachment for meters, quick-action voltmeter switches, electroscopes, portable cable-testing sets, cable hangers and phase-rotation indicators. The company is also carrying on a breakdown test on minerallac. C. I. Hall, H. S. Sines and C. C. Lovejoy are in attendance.

National Carbon Company, Cleveland, O., is exhibiting a full line of Columbia multiple batteries, Columbia dry cells, Columbia novelty batteries, Columbia lighting carbons, for enclosed and open flaming arcs, together with a full line of carbon brushes for motors and generators. The exhibit is in charge of Messrs. King, Stowe, Crider and Turner.

National Electric Lamp Association occupies four large booths immediately to the left of the main entrance to the arena. The exhibit this year is as usual a large and instructive one and includes several new and interesting features, a few of which are as follows: A display of Mazda train-lighting lamps; the "Holophane Tree," a large statuary bronze fixture about nine feet in height upon which are shown burning, six each of the different sizes of Mazda-Holophane units with satin-finish reflectors; a glass-inclosed metal display rack showing about forty of the different types and sizes of Mazda miniatures; a small "peekaboo" case in which the relative color values of the carbon and Mazda lamps are compared; the large 500-watt Mazda lamps with reflector sockets; the new multiple clusters using Mazda lamps and metal porcelain finish reflectors. In addition to the above, the regular line of 110 and 220-volt Mazdas are shown as well as tantalum lamps for the same voltages. These lamps are exhibited both cold and burning on attractive display racks. The miniature photometer, which shows the relative amount of light received from a carbon and from a Mazda lamp of the same wattage, gives a rough idea of the type of apparatus used in lamp photometry, while the small mirror rotator, an arrangement of mirrors within a box-like frame which in turn surrounds a Mazda-Holophane unit, shows the general method of obtaining distribution curves on the different lighting units used in all types of illumination. The Association is represented by J. R. Crouse, S. E. Doane, G. C. Webster, C. W. Bender, N. H. Boynton, W. W. Dodd, Ralph Beman, C. P. Soderberg and H. J. Raymond.

Henry Newgard & Company, Chicago, Ill., is exhibiting a line of high-grade panel boards, steel cutout cabinets and other electrical specialties of its own manufacture. The Company is represented by Henry Newgard, Martin Newgard, Chester Johnson, F. G. Smith and H. B. Harvey.

North Shore Electric Company, Chicago, Ill., has on exhibition a large map showing the territory served by the Company. Each town receiving service is indicated by a miniature tungsten lamp and the transmission lines of the Company are also shown. This Company is making special efforts to call attention to the desirability of industrial plants locating in its territory and is also featuring its plan of wiring old houses for electricity, allowing twenty-four months to pay.

Nuway Service & Sales Company, Chicago, Ill., is exhibiting a complete line of vacuum cleaners comprising the Nuway electric suction cleaner which weighs complete twenty-five pounds, the Atwood one-quarter horsepower portable electric vacuum cleaner, the one-half horsepower light-duty stationary plant and the one-horsepower standard stationary plant. A. W. Nohe, I. A. Nohe, W. M. Stewart, C. A. Stewart, T. C. Phillips, S. B. Atwood and James Atwood are in attendance.

Ohio Electric Company, Toledo, O., is exhibiting an electric coupé equipped with thirty cells. The feature of this car is the magnetic controller and shaft drive. The company is represented by I. O. Slater, George McClain and H. W. Corris.

Pelouze Electric Heater Company, Chicago, Ill., is exhibiting the new Pelouze toaster-stove and griddle and its new copper-top disc stoves, both of which have been produced since the last Electrical Show in Chicago. In addition, the exhibit includes irons, coffee percolators, chafing dishes, water cups, tea kettles, etc. The exhibit is in charge of W. Nelson Pelouze, Chas. P. Madsen, A. A. Guardia and Clark Bros.

Perfection Vacuum Cleaner Company, Chicago, Ill., is exhibiting its complete line of electric vacuum cleaners, which comprise various types of portable cleaners for domestic use and stationary plants, for use in hotels, office buildings, etc.

Philadelphia Storage Battery Company, Philadelphia, Pa., is maintaining a complete exhibit of vehicle batteries and parts, sparking batteries and parts and auto-lighting batteries and parts. The Company is represented by Carl Klemp.

Ralph Temple Automobile Company, Chicago, Ill., is exhibiting Baker electric vehicles. This exhibit of Baker's constitutes two coupes painted and trimmed; one body in the white and one chassis changing the entire electric mechanical construction of the Baker electric. Those in attendance are Ralph Temple, W. E. Croswell, R. S. Givins, C. R. Kyte, Walter Bender, H. J. Butler, John Beatty, E. A. Blake and A. H. Hampter.

Rider-Ericsson Engine Company, Chicago, Ill., is exhibiting a number of its machines prominent among which are its electric house pump, turbine pump and triplex pump. The house pump is novel in that it can easily be converted into a deep-well pump. The Company is represented by Mr. Houghtaling.

Rosenfield Manufacturing Company, New York, N. Y., is conducting a working exhibit of its electric vacuum cleaners. These machines weigh but ten pounds but are given very severe tests by the demonstrators. In addition there is shown a com-

plete assortment of attachments for various cleaning operations.

Sefton Manufacturing Company, Chicago, is exhibiting a complete line of corrugated paper, corrugated fiber board boxes for express and freight shipments, corrugated fiber board boxes for shipping electrical goods, telephones and accessories, and special folding boxes to hold transmitters, telephone receivers, etc. The exhibit is in charge of R. E. Ferguson and W. H. Fairchild.

Simplex Electric Heating Company, Cambridge, Mass., is exhibiting an entirely new feature this year consisting of bread-baking in quantities by electricity. The baking is done by H. H. Kohlsaat & Company, and the bread baked is donated to the United Charities by the Simplex Electric Heating Company, H. H. Kohlsaat & Company and Commonwealth Edison Company. The type of oven used is adaptable for hotel, bakery or restaurant use. Besides this there are numerous appliances especially adaptable for hotel and restaurant use, such as the broiler, toaster, etc. There is also a large exhibition of dining-room sets, toasters, irons, heating pads, etc., and a general line of electric heating and cooking appliances. The following members are in attendance: H. R. Hixson, H. F. Holland, W. F. Hruby, J. N. Mcalister, H. B. Fyfe and E. R. Jacobs.

Stamping Washer Works, Chicago, Ill., is exhibiting a number of its Home Queen Stamping washing machines, equipped for motor drive, also a double compartment family size motor-driven washers, handpower and waterpower washers. Several of these machines are shown in operation. The Company is represented by M. D. Coffeen, C. B. Coffeen, N. G. Rothstein, and M. J. Martin.

Stolz Electrophone Company, Chicago, Ill., is making an attractive display of the Stolz Electrophone, a device for the deaf, which improves the natural hearing. This device is demonstrated and subjected to various tests by the operators. The company is represented by F. D. Gustin.

Studebaker Automobile Company, South Bend, Ind., has on exhibition a two and one-half ton electric truck, a 1,000-pound light delivery wagon, a Victoria and a coupé pleasure vehicle. The company is represented by F. H. Hooper and J. G. Lewis.

Subway Telephone Construction Company, Chicago, Ill., is exhibiting a complete automatic telephone exchange, to which a number of telephones about the exhibit are connected. This equipment is manufactured by the Automatic Electric Company, and is the same as is being installed in Chicago. The company is represented by Fred S. Williams, J. C. Lang, W. N. Curtis and William Stroud.

Swedish-American Telephone Company, Chicago, Ill., is exhibiting a complete and up-to-date line of magneto apparatus; but features particularly its new combined electric clock and telephone. This is an instrument recently placed on the market and, in fact, it is the only telephone with a clock attachment where the clock is operated without any extra wires or anything of that kind; but all of the apparatus to operate the clock and telephone are contained in the one instrument. There is also shown the radio desk telephone holder and the new unit-type switchboard. Those in charge of the exhibit are: E. B. Overshiner, A. V. Overshiner, Fred Seeley and W. O. Rhode.

Tel-Electric Company, Chicago, Ill., is demonstrating the Tel-Electric piano player attached to a number of standard make pianos. This exhibit is conducted in a sound-proof room and concerts given daily. The exhibit is in charge of G. A. Pond.

Thordarson Electric Manufacturing Company, Chicago, Ill., is showing a complete line of ignition coils, bell-ringing transformers, sign-lighting transformers and toy transformers; also a complete line of laboratory and experimental apparatus. Electric fireless cookers are also shown. The exhibit is in charge of A. R. Johnson.

Toledo Electric Welder Company, Cincinnati, O., is exhibiting three electric welding machines; one small welder for welding one-quarter-inch wires or less; one electric welder, which is used in butt welding samples of different kinds of iron and steel; one spot welder for electric riveting. This machine is operated to show riveting by the electric method "without using rivets." There is also displayed sample boards, showing the great variety of electrically welded devices, as, for instance, automobile rims, base-ball masks, tin bread pans, printers' chases, carriage dash frames, ball bearings, sheep shears, bed casters, automobile parts, carriage hardware, pail hoops, wire chairs, molders' chaplets, bicycle fittings, steel screens, horse bits, baby cab tires, etc., etc. A. M. Searles, A. M. Anderson, Neil Macneale and Frank Warren, are in attendance.

Union Light & Supply Company, Chicago, Ill., is exhibiting a full assortment of "Just" imported tungsten lamps, in sizes ranging from 16 to 1,000 candlepower; a complete line of Delco heating devices, comprising combination sets, chafing dishes, percolators, electric soldering irons, glue pots, flatirons, etc.; Shaler electropads, vulcanizers and stoves; Acme heaters and Electra carbons. The exhibit is in charge of Josef F. A. Comstedt.

Van Manufacturing Company, Braddock, Pa., is exhibiting a complete line of electric irons in sizes suitable for home and laundry use. Various parts of the iron are also shown. The Company is represented by D. O. McAlbiter.

Vulcan Electric Heating Company, Chicago, Ill., is exhibiting a full line of electrical soldering, branding and capping tools, electric curling irons and accessories. Those in attendance are F. J. Holmes, M. Y. Steen, A. G. Sutcliffe, S. W. Richards, L. Sisskind and H. L. Wuerffel.

Westinghouse Electric & Manufacturing Company is exhibiting jointly with the Westinghouse Lamp Company and the Cooper Hewitt Electric Company. The feature of the Westinghouse Electric exhibit is a new adjustable-speed alternating-current, mill-type motor, which the Company has just brought out. The detail and supply apparatus exhibited comprises cooking and heating devices, meters, transformers, rectifiers, etc. Several new 1911 model fan motors are shown; these include twelve-inch and sixteen-inch mechanically oscillated types for both wall and desk mounting, and a twelve-inch exhaust type for ventilating purposes. A demonstrator shows how easily and quickly the general utility motor can be adapted, by means of its attachments, to a dozen different uses. Another demonstrator cooks dainties in an electric chafing dish and serves them to visitors. A toaster stove lends itself readily to cooking batter cakes, frying chops and bacon, and popping corn. The Company is represented by T. P. Gaylord, W. R. Pinckard, A. L. Millard, M. MacNeill, R. W. Everson, F. A. Servis, J. W. Robinson, H. L. Garbutt, H. J. Brown, R. H. Moore, E. M. Bischoff, C. A. Carpenter, F. O. Creager, Stephen Gardner, C. W. Regester, J. W. Busch, A. M. Miller, D. E. Webster, W. H. Beattys and H. H. Coughlan. The Westinghouse Lamp Company is exhibiting a complete line of 110-volt "wire type" tungsten lamps, ranging in size from twenty-five watts to 500 watts, and of 220-volt "wire type" lamps, ranging in size from forty-five to 500 watts. Street-series tungsten lamps are shown in different sizes, ranging from fifty to 250 watts. Among those in attendance representing the Westinghouse Lamp Company are the following: J. M. Schilling, A. N. Brown, C. R. Wood. The Cooper Hewitt Electric Company is displaying a direct current and an alternating current lamp. These are mounted in an attractive manner, which shows the operating mechanism. Literature is being distributed showing several well-known installations of Cooper Hewitt lamps in factories, warehouses and roundhouses. The Company is represented by Irving B. Carey. The entire exhibit is in charge of W. Barnes, Jr., of the Westinghouse Department of Publicity, East Pittsburg, Pa.

Minneapolis Plant Burns.

On Friday, January 7, the plant of the Minneapolis General Electric Company was almost totally destroyed by a fire which is said to have originated with the short-circuiting of the 13,000-volt lines. The damage done to the company is estimated at $500,000.

For a while the city was in darkness, but after a time, due to the efforts of the company officials, the 220-volt service was resumed. Later, through connection with the lines of the Twin City Rapid Transit Company, power was transmitted to the consumers on the 500-volt lines. Power for lighting the residence district has been arranged for, but there is said to be but little hope of adequate street lighting for some time to come.

The plant, which is operated by Stone & Webster, of Boston, will be rebuilt by them as soon as possible.

Change German Electrical Standards.

The change in the value assigned to the normal Weston cell, as a standard of electromotive force, which has been decided upon by international agreement, as announced in our columns last week, went into effect in Germany on January 1. The change is not so great as in this country, as they have been using the value 1.0186 volts and the change to 1.0183 volts increases the size of the units of current and voltage by 0.03 per cent, and the unit of power by 0.06 per cent.

Announcement of the change was made by the Reichsanstalt in December.

New Cable Route to Spain.

New lines which have been established in Spain give a much more direct cable route to the United States than was hitherto obtainable. It was formerly necessary for messages between Barcelona and the United States to be transmitted overland to Paris.

A line has now been constructed from Barcelona to Bilboa. Messages sent over this line will go to Bilboa, then direct to England, and to the United States.

Electrical Notes From Great Britain.

By Our British Correspondent.

Two of the leading public electrical undertakings in Australia are those supplying electric light and power to Adelaide and Melbourne. Both are owned by English companies, and, judging from information recently issued in London, where their head offices are situated, their businesses have grown very satisfactorily during the past official year. At Adelaide an aggressive policy of extending mains into the residential and manufacturing districts around the city has enabled the Adelaide Electric Supply Company to pay nine per cent on its ordinary shares, and to carry to dividend equalization account $75,000 for the year. The power load increased from 2,369 horsepower to 3,101 horsepower, and the lighting load from 91,338 to 112,154 thirty-watt lamps. In addition the Company has been giving a temporary supply to the Municipal Tramways Trust for working the Adelaide tramways, which alone produced an income of $163,000. It is expected, however, that the power station of the Trust will be completed in the course of a few months, so that the Company's supply will not be required. It is anticipated that, owing to the rapid growth of the suburban light and power business, a considerable proportion of the loss will be made up for by new connections. There are at present 500 consumers waiting to be connected, mainly in the suburbs. The capital of the Adelaide company is being increased by $500,000. There is said to be some likelihood of the municipal authority exercising its right to purchase the system, and the date provided for this is December, 1911.

The position at Melbourne, while not enabling the Melbourne Electric Supply Company to pay so generous a dividend as is paid at Adelaide, is improving remarkably. There has been an increase of twenty-five per cent in units sold, and this is held to be extremely satisfactory in view of the fact that the full burden of the universal adoption of metal-filament lamps has had to be borne. It was thought that perhaps this change would have been met by the demand from new consumers, but as a matter of fact the power sales were much in excess of those of the previous year. New customers were 908 as compared with 370 for last year, and the increase of revenue was $35,000. The Melbourne Company will supply from its Geelong works the Geelong tramways, which are expected to be ready to run this year, and a hope is expressed that these tramways will create a bigger demand for electricity for all purposes in Geelong. In regard to the Melbourne Company's undertaking generally, it is worth noting at what a phenomenal rate business has been progressing quite recently. Last year the new customers connected averaged seventy-five per month, but this year 228 new connections were made in September and 251 in October. For some years past the Melbourne Company has not been able to pay dividend on its six-per-cent-cumulative-preference stock. It has now capitalized its obligations in this respect by issuing new income bonds.

The paper which was read by E. W. Marchant before the December meeting of the Illuminating Engineering Society need not be gone into, as it has already been abstracted in THE ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of December 31. In speaking along somewhat the same lines as Mr. Marchant, Prof. G. W. O. Howe mentioned some interesting points connected with the blackening of tungsten-lamp globes. This blackening was, he stated, found to have occurred at the upper part of the bulbs, the part near the cap being heavily coated with a brilliant copper-colored deposit. A relatively clear unblackened pattern had, in the tests, been made on the globe, indicating that the blackening had been caused by particles projected from a given point, and it was found that the bombardment proceeded from the joint where the filament was connected to one of the leading-in wires. It was at this point that two out of three broken lamps had given way. The brilliant copper coloring near the cap was due to the blackening being so thick that it acted as a mirror, reflecting nearly all the external light falling upon it. There were two shadowgraphs side by side in each lamp, the foci being the two joints between filament and leading-in wires. The deposit was stated to consist mainly, if not entirely, of copper, and the leading-in wires contained a certain amount of copper. It seemed that the copper particles, which appeared to be torn off the cathode and shot radially outwards, must proceed from the leading-in wire, their liberation being favored by the heating of the end of the wire by conduction from the filament. Mr. Howe said that the lamps were made in Germany, and if the makers had not changed their methods or materials of manufacture since the lamps were made, they could now, by excluding copper from the joints, reduce the blackening to a large extent, and at the same time reduce the probability of breakage.

There have been many interesting meetings of electrical men this month. A. J. Cridge, of Sheffield Corporation, electricity department, opened a discussion at the Yorkshire section of the Institution of Electrical Engineers on December 7, in which he gave figures showing what had been, or could be, done with some of the more modern electrical apparatus, as a basis for remarks. Both manufacturers of such apparatus and electricity works engineers who "had to live with their customers," to use Mr. Cridge's expression, took part in the proceedings, which undoubtedly were of great practical value, especially coming at a time when everybody desires this department of electrical industry to be rapidly developed, but on a sure basis, both as to suitability and convenience of the apparatus itself and as to the cost, both initial and working.

The Association of Mining Electrical Engineers is going to hold its first examination, to which I recently made reference, early in 1911. At Newcastle, on December 3, its members discussed R. R. Smith's paper on "Inspection and Repair of Electrical Plant Underground." The East of Scotland Branch of the same association has just discussed the same paper.

The London Institution of Electrical Engineers on December 8 considered and discussed Sir R. A. Hadfield's and Prof. Bertram Hopkinson's combined paper on magnetic properties of iron and its alloys in intense fields, and on December 15 Maj. W. A. J. O'Meara in a full paper on "Submarine Cables for Long-Distance Telephone Circuits" gave, among other matters, an account of the recently laid Anglo-French telephone cable and a copy of its specifications.

The Manchester section on December 20 discussed Merz-Price and other discriminative protective apparatus for alternating-current circuits, on which a paper was written by K. Faye-Hansen and G. Harlow. An important evening at Newcastle was that of December 19, when H. W. Clothier spoke on "Switch Gear and the Isolation of Faults on Power Systems." Mr. Clothier said that the primary considerations governing the design of successful automatic switch gear were: (1) A thorough understanding of the functions which the apparatus has to perform; (2) a rigid elimination of unnecessary parts; (3) a construction affording maximum security with minimum supervision and maintenance. The essential considerations in switch-gear design considered from the protection point of view were: reliable automatic operation under fault conditions; inoperative whatever the condition of the load while the section which it protects is sound; freedom from risks of shocks and burns; freedom from breakdown under all working conditions; reduction of cleaning, testing and supervision to a minimum; robustness of construction to withstand all kinds of rough usage and to eliminate fire risks; ready access to those parts where regular inspection is unavoidable; protection against shock by the automatic isolation of such parts before it is possible to handle them. After describing certain apparatus Mr. Clothier concluded by considering how this apparatus had complied with the essential conditions above enumerated. He said that reliability in the automatic isolation of a faulty section without disturbance to the sound sections had been obtained by the use of the balance system of protection, while older systems of protection had been uncertain in their action, failing more especially in the discriminating factor. Freedom from shock and burns had been obtained by the avoidance of exposed bare conductors. Freedom from breakdowns had been secured by using insulating compound as a filling medium between conductors throughout, this taking the place of air insulation in many other types. The inclosure of all conductors and insulators carried with it a reduction in the maintenance work, including cleaning, inspecting, testing, etc., and also eliminated the risk of the insulating being lowered by conducting fumes, moisture, etc. Robustness of construction had been obtained by armoring, and switch gear so constructed compared with other types of apparatus just as an armored cable in rough service would compare with a non-armored one. The routine maintenance of switch gear had been confined to the switch-contact operating mechanism and the protective relays, and whereas the inspection of apparatus on some switch gear designs involved great risks, there were interlocking arrangements which had furnished a means for effecting this work in safety.

ALBERT H. BRIDGE.

LONDON, DECEMBER, 1910.

Overhead Electric-Railway Construction.

Theodore Varney, electrical engineer with the Westinghouse Electric & Manufacturing Company, lectured before the electrical engineering seniors at the University of Minnesota, December 14, 1910, upon "The Development of the Overhead Construction in the Electrification of the New Haven Railway." Following somewhat the lines of his 1905 paper before the American Institute of Electrical Engineers he discussed the development of the single and double-catenary construction for high-speed electric railways.

The choice of the bridge system of supporting conductors for the four-track road was proposed by George Westinghouse as a desirable adaptation of the bridges already in use for block signals. A line was divided into sections approximately two miles long, coinciding with the length of the blocks of the signal system. On the curves, which in no case exceeded three degrees, a single pull-off was erected in the middle of the span between each two bridges, thus keeping the contact conductor within nine inches of being directly over the center of the track. In order to insure stability, the bridges were designed to withstand, with ample factor of safety, a wind pressure of one hundred miles per hour when everything was covered with sleet to a depth of one-half inch in zero weather. The tendency of the contact conductor to curl on account of torsional strains introduced by reeling and unreeling was counteracted by the use of laterally bridged hangers, and by use of the "V" double-catenary supports. The tendency of the contact conductor to kink near the support as a result of the blow of the collecting devices striking the hanger, at 60 to 70 miles per hour, was met by suspending below the origingal conductor the second conductor having a section with an elongated vertical axis. The height of the contact conductor above the track varies on account of the change in temperature affecting the tautness of the steel suspension cable. A conductor which is ordinarily 22 feet above the track is depressed to 15 feet when passing under certain bridges which cross the track. On the approaches to these bridges the contact conductor was originally given a gradient of two per cent, but this was found to be too steep, the collector jumping when a train passed under the bridge at high speed. This difficulty was removed by changing the gradient to one per cent. Special problems in the design of the collector were involved in securing reliable contact with a conductor whose height varied about seven feet, and in minimizing the blow due to the collecting device striking the hangers at the high speeds of 60 to 70 miles per hour. This was solved by use of a pantograph, made of steel bicycle tubing reinforced near the base and controlled by levers operatd by air pressure. Various collecting devices were considered, the choice finally setting upon a sheet steel shoe which was light and which could be renewed at slight cost. This shoe has a deep groove which is filled with graphite and grease at the end of each round trip. The shoe is provided with aluminum horns for added safety at crossings. On account of the high speed at which diagonal crossings are passed, it was necessary to develop a means gradually raising the diagonal wire as the train approached. This was accomplished by an ingenious arrangement of radial wires near the crossing points. The circuit breakers on the bridges at the ends of the two-mile sections were found to act too quickly as originally installed, the heavy short-circuit on the conductor over one track opening not only its own circuit breaker but also those governing the other conductors, which at the instant all fed into the defective line. This was corrected by the use of several circuit breakers in series with the main feeder, each shunted by a resistance and having such a time-element that the main feeder was opened by successive steps. Other time element devices applied to the circuit breakers in the contact line successfully limited the tripping of the circuit breakers on the bridge to the single one on the defective circuit.

P-A-Y-E Cars for Detroit.

The Detroit United Railways, which now operates about 300 cars, has closed a contract with the Pay-As-You-Enter Car Corporation for fifty new cars. A large number of old cars will be altered to the standard P-A-Y-E model.

New Laboratories at University of Nebraska.

The new laboratories of mechanical engineering at the University of Nebraska, Lincoln Neb. will be dedicated on January 18.

A STUDY OF UNBALANCED MAGNETIC PULL.

BY CHARLES R. MOORE.

A motor or generator armature, if placed concentric with the pole shoes, experiences no force of translation, except that due to gravity. The air gaps are all of equal length so the average air-gap flux density is the same at all pole faces. Therefore the pull upon the armature of any one pole is exactly balanced by the pull of the pole diametrically opposite, regardless of the value of excitation or the shape of the magnetization curve. If, however, the armature is so placed as to be slightly eccentric, relative to the pole shoes, the air gaps become of unequal length, and the reluctances of the various magnetic circuits differ. The air gaps, so situated as to be near the diameter, along which the armature center has been shifted, experience the greatest change; those toward which the movement occurs become less, while the opposite air gaps become greater. The air gaps placed at some angle from the diametrical line referred to, change their length approximately proportional to the cosine of this angle.

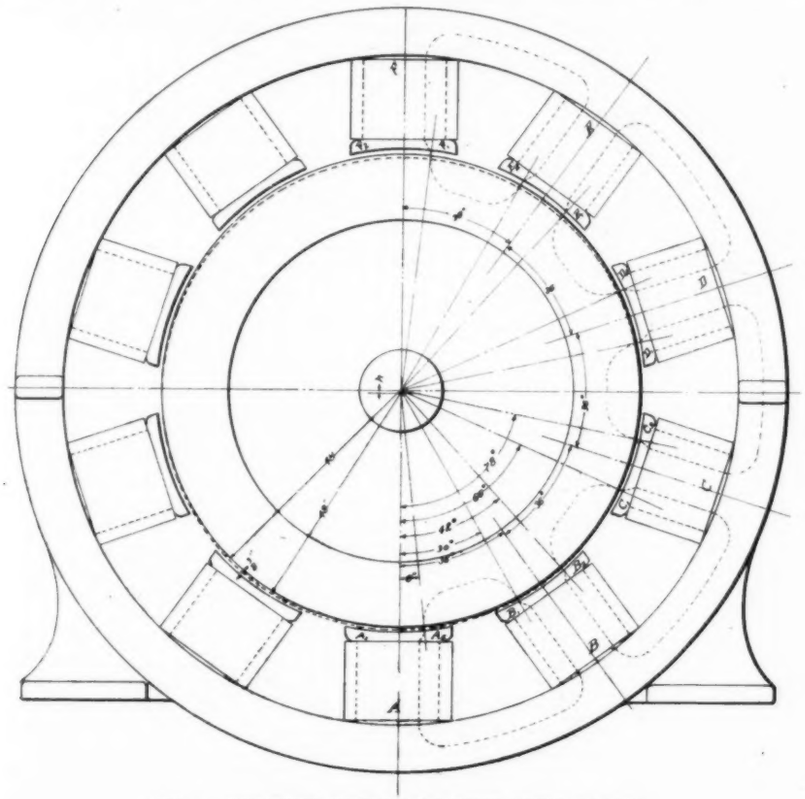


FIG. 1.—SHOWING EFFECT OF DISPLACING ROTOR.

It is obvious, therefore, that more flux will enter the armature from the poles, toward which the movement occurs, and less flux will enter from the opposite poles for any given value of excitation. This means that the pull of the poles, toward which the movement occurs, will exceed the pull of the poles opposite, and a force of translation is set up magnetically. This added stress must be borne by the shaft and bearings, which, therefore, should be designed to carry a reasonable amount of such loading, since under practical conditions of operation, it is impossible to keep the armatures accurately centered at all times. Another point, not to be passed unnoticed, is that whenever a displacement of an armature occurs, the frame on the side toward which the movement takes place is subjected to greater deflection stresses than occurs under theoretically ideal conditions. These conditions should be carefully considered when the frame section is decided upon.

The value of this stress, to which the armature and the frame are subjected, is dependent upon the eccentricity and the excitation. In most designs, the air-gap reluctance is by far the largest single reluctance in the magnetic circuit at normal flux densities, so that a large change in air-gap length causes a correspondingly large change in total flux. Furthermore, since the pull between two parallel surfaces, between which magnetic flux is passing, varies as the square of the flux density, the difference between the attractions of the poles toward and from which the movement is taking place, is greater than one at first thought might suppose. It is necessary, therefore, in all important designs to investigate the extent of this unbalanced magnetic pull, under conditions of practical operation.

If the magnetization curves of the various magnetic circuits were straight lines, simple formulas could be developed whereby this unbalancing of the magnetic circuits could be calculated, for all air-gap lengths and values of field excitation, but knowing that these curves have a "knee" more or less sharply defined, the curvature of which is a function of the air-gap length and the quality of the materials making up the remaining portion of the magnetic circuit, formulas to meet all the various conditions would indeed be complicated.

The following method, which is more or less graphical, affords a ready means for studying this unbalanced magnetic pull under all practical conditions of operation. Its chief value lies in the fact that higher mathematics are not needed for its clear understanding. Any one familiar with curve plotting, ordinary algebraic equations, and the elements of trigonometry will find little difficulty in applying it. But previous to its application, however, data concerning the saturation curve, normal average air-gap density, pole-face area and normal air-gap length must be at hand.

The method in brief is as follows. For the entire magnetic circuit the no-load saturation curve should be plotted. (This, of course, should show the relation between ampere-turns per pair of poles and the air-gap density. See Curve D, Fig. 2.) Another curve showing the relation between the ampere-turns per pair of poles and the air-gap density for a double air gap only, should be drawn. This curve will of course be a straight line. (See dotted line OC Fig. 2.) By subtracting the abscissas of the double air-gap curve, from those of the curve for the entire magnetic circuit, a curve will be ob

tained showing the relation between the ampere-turns per pair of poles and the air-gap density for the iron parts only of the entire magnetic circuit. (See Curve A, Fig. 2.) It is obvious that one has merely to combine with this curve the abscissas of a line showing the relation between ampere-turns per pair of poles and average air-gap density for any double air-gap length desired, in order to obtain the magnetization curve for a complete magnetic circuit after this new double air-gap length has been introduced. By making a series of such combinations, a new set of curves may be plotted showing the relation between the length of double air-gap and average air-gap densities for various values of excitation. (See Fig. 3.)

In Fig. 1, a side elevation of a ten-pole machine is shown in outline and the paths of the various magnetic circuits are denoted by the dotted lines. If one scans this sketch one will find that the pole arc should be divided into two equal parts and that the adjacent halves of adjoining poles belong to any given magnetic circuit. It is obvious therefore, that the change in air-gap length, for a given displacement of the armature center, should be measured at the middle of these half polar arcs in determining the change in double air-gap length for each magnetic circuit. It is also obvious that since each magnetic circuit is complete in itself, the average magnetic density at these half arcs, will be equal. It is further obvious that the pull between any pole shoe and the armature should be calculated on the basis of half the pole-shoe area and the density thereat. This may be easily done by plotting a curve, as shown in Fig. 4, which is derived from the equation

$$P = \frac{B^2 A}{11{,}200{,}000}$$

where P equals the pull in pounds, B equals the air-gap density in maxwells per square centimeter and A equals the area of half the pole face in square centimeters.

For a given displacement of armature center the length of the air gaps at the middle of the various half polar arcs may be measured or calculated. Adding together the air-gap lengths of adjacent half arcs of adoining poles the double air-gap length for any magnetic circuit may be obtained. From the curves in Fig. 3, the average air-gap density for these half-arcs may be found for any desired excitation. From Fig. 4, the pull radially can be found and laying off this pull on the radius passing through the middle of the half-arc considered, the pull in the direction of armature displacement can be measured. (It may also be calculated by multiplying the radial pull by the cosine of the angle between said radius and the diameter along which the displacement occurred.) Summing up these various components for all half polar arcs the total unbalanced magnetic pull for the excitation and armature displacement considered is obtained. This may be repeated for various excitations and displacements.

As an illustration of this method, the unbalanced magnetic pull on the armature of a large multipolar machine has been worked out for all possible displacements of the armature from zero at full air-gap length and for all possible excitations from zero to a value as high as the field coils could stand in practice. This machine has the following specifications: output, 550 kilowatts; voltage, 550; number of poles, 10; speed, 90 revolutions per minute. Some of the data concerning the magnetic circuits are as follows: normal air-gap length, 0.375 inch; total area of pole face, 42 square inches (area of

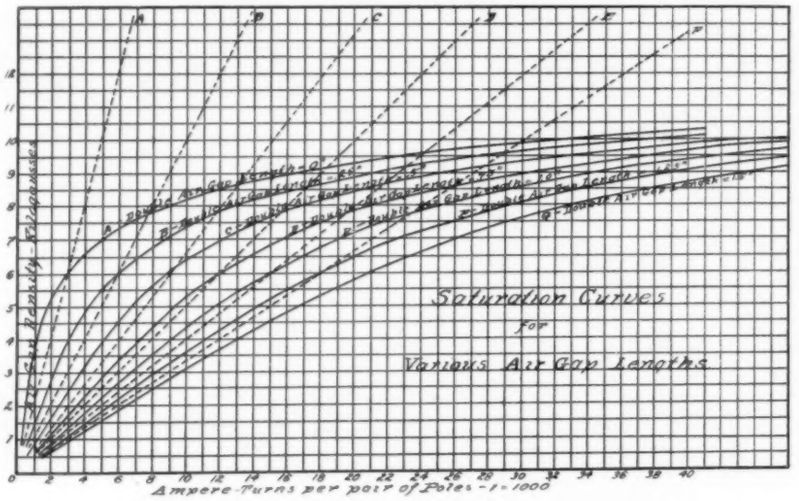


FIG. 2.—SATURATION CURVES FOR DIFFERENT AIR GAPS.

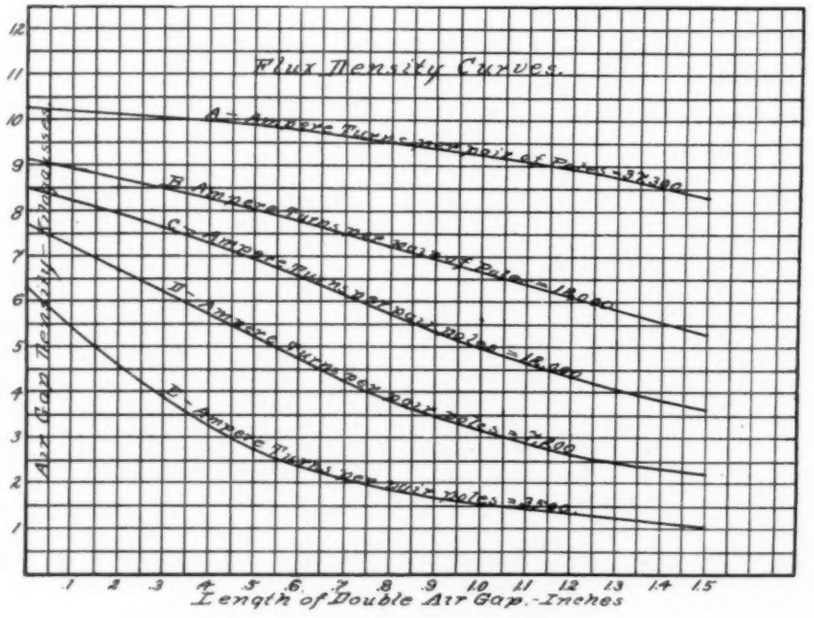


FIG. 3.—FLUX-DENSITY CURVES.

half pole face, 1,380 square centimeters); and normal air-gap density, 7,600 gausses. 18,000 ampere-turns per pair of poles, are required for this value of air-gap density.

An outline side elevation of this machine is shown in Fig. 1. The machine having ten poles and the percentage of the armature surface covered by pole faces being 70, each pole shoe spans about 25 geometrical degrees. This means that the middle of the half polar arcs (the points at which the air-gap length should be measured after displacement occurs) are removed about 6 geometrical degrees from the midpoint of the pole shoe. The direction of displacement of the armature center is taken vertically downward and poles A and F are placed in a vertical position. (Data concerning the effect of having the movement occur along a diameter bisecting the angle between two poles were obtained which showed that it made little difference which diameter the displacement follows.) The change in air-gap length need be measured at but four half polar arcs, namely:—A_2, B_1, B_2, and C_1 for the reason that equal changes, but in the reverse sense, are occuring at F_1, E_2, E_1, D_2 respectively. Half polar arcs C_2 and D_1 need not be considered for the reason that, being in the same magnetic circuit their average densities are equal and their vertical components of pull will be equal and opposite. The left hand side of the armature need not be considered for the reason that its unbalanced magnetic pull will be equal to that of the right side. The total unbalanced pull will be twice that of the right side.

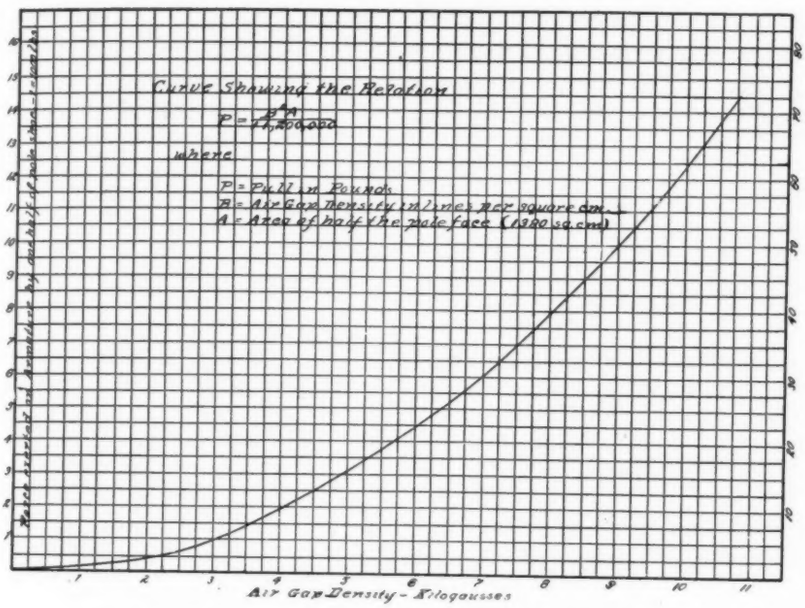

Curve Showing the Relation
where
P = Pull in Pounds
B = Air Gap Density in Lines per square cm.
A = Area of half the pole face (1380 sq cms)
Air Gap Density - Kilogausses

FIG. 4.—VARIATION OF FORCE WITH FLUX DENSITY.

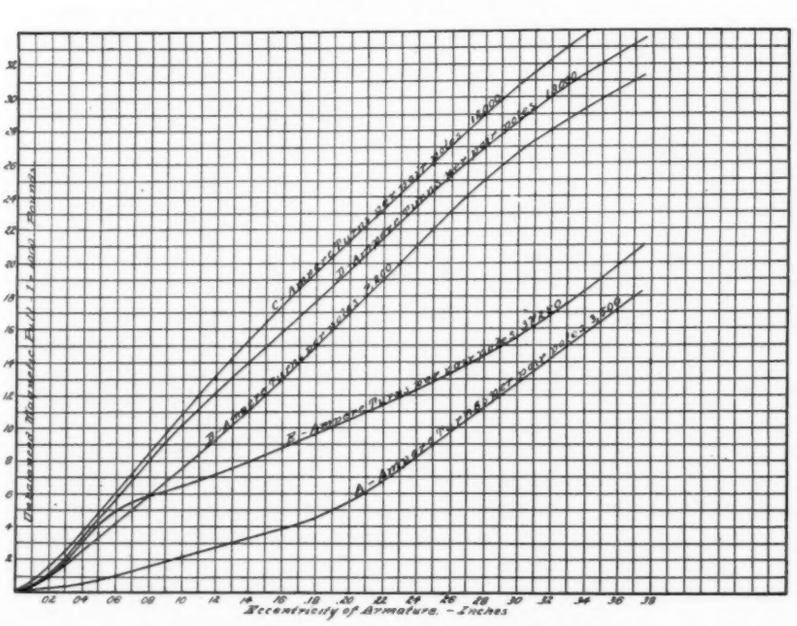


FIG. 5.—VARIATION OF FORCE WITH DISPLACEMENT.

Fig. 2, Curve D, shows the relation between the ampere-turns per pair of poles and the air-gap density for this machine when the double air-gap length is normal. Dotted line OC is the magnetization curve for normal double air gap. Substracting the abscissas of OC from those of Curve D gives Curve A, which shows the relation between ampere-turns per pair of poles and air-gap density when the double air-gap length is zero. With Curve A the excitation curves for other double air-gap lengths may be combined giving curves showing the relation between ampere-turns per pair of poles and air-gap density for various lengths of double air gap. Fig. 4 is a graphical solution of the equation

$$P = \frac{B^2 A}{11{,}200{,}000}$$

where A = 1,380 square centimeters.

For purposes of illustration a displacement of 0.1 inch will be permitted and the unbalanced magnetic pull, for a specific value of excitation, 12,000 ampere-turns per pair of poles will be solved. By calculation the air-gap length at A_2 is found to be 0.276 inch and for B_1 0.288 inch. These values were found as follows: the change in air-gap length at A_2 is $0.1 \times cos6^\circ$ = .099. Substracting this value from 0.375 (normal air-gap length) gives 0.276. Likewise at B_1 the change in air-gap length is $0.1 \times cos30^\circ$ = 0.087, giving an air-gap length at B_1 of 0.288 inch. Summing up these values the double air-gap length for the magnetic circuit A_2 B_1 is found to be 0.564 inch. In a similar manner the double air-gap length for the magnetics B_2 C_1 and D_2 E_1 are found to be 0.865 inch and 0.936 inch respectively. If one displacement and excitation only were to be considered, portions of the magnetization curves near the chosen value of excita-

tion embodying these new air-gap lengths could be easily derived as explained above from which the magnetic densities could be read. However since all possible displacements are to be considered, it is preferable to derive a series of saturation curves from various double air-gap lengths as shown in Fig. 2, and to obtain therefrom the curves shown in Fig. 3, which indicates the relation between the length of double air gap and the air-gap density for various values of excitation. From these curves the air-gap densities at any half polar arc, for any given displacement, can be easily obtained.

We find from Curve C, Fig. 3, that air-gap densities at half polar arcs A_2 and B_1 will be 6,740 gausses. From Fig. 4 the pull between armature and each of these half pole shoes (A_2 and B_1) is 5,600 pounds. Laying off this value on the radii passing through the middle of these half polar arcs, the component in the direction of displacement scales 5,560 pounds for A_2 and 4,850 pounds for B_1.

In a similar manner we find that the pulls in the direction of displacement for B_2, C_1, D_2, E_1, E_2, F_1 are 3,750, 2,055, 1,446, 2,822, 2,945 and 3,080 pounds respectively. It will be noted that the last four values indicated an upward pull, while the first two, and those calculated for A_2 and B_1 indicate a downward pull. Summing up these values we find that the downward pull is 16,215 pounds and the upward pull 10,693 pounds giving an unbalanced pull of 5,522 pounds for the right-hand half of the armature. The total unbalanced magnetic pull on the armature for a displacement of 0.1 inch and an excitation of 12,000 ampere-turns per pair of poles is therefore 11,044 pounds.

The results of similar calculations for various eccentricities and excitations are shown in Figs. 5 and 6. Fig. 5 shows the relation between displacement and unbalanced pull for five values of excitation. Scanning these curves it will be noticed an excitation of 12,000 ampere-turns per pair of poles shows the largest unbalanced pull for all eccentricities and that an excitation of 37,250 ampere-turns per pair of poles causes but little more unbalancing than an excitation of 7,250 ampere-turns per pair of poles, and at high values of eccentricities causes considerably less.

Fig. 5 also shows that for values of excitation from 7,000 up and for eccentricities from 0 to about 0.08 inch, the unbalanced magnetic pull is approximately proportional to the eccentricity. At larger eccentricities the curves vary widely. It will further be noted, for excitation values 7,000 and 18,000 ampere-turns per pair of poles, the unbalanced pull is practically proportional to the displacement for all.

In Fig. 6 are curves showing the relation between ampere-turns per pair of poles and unbalanced magnetic pull for five values of eccentricity. These curves show that the unbalanced pull reaches a maximum at about 12,000 ampere-turns per pair of poles for all eccentricities and tend to approach zero at some excitation in the neighborhood of 60,000 ampere-turns per pair of poles. This is explained by the fact that as the iron parts of the magnetic circuits become saturated their reluctance rises and a value may be reached where the air-gap reluctance is a small percentage of the total. At this point changes in air-gap length cannot greatly affect the reluctance of the magnetic circuit as a whole, and the air-gap densities remain practically constant for all eccentricities.

Fig. 6 also shows that in case a given machine requires for normal operation an excitation above that giving the maximum unbalanced pull, the shaft, bearings and frame may be subjected to much higher stresses, while the machine is building up than those obtaining at normal voltage.

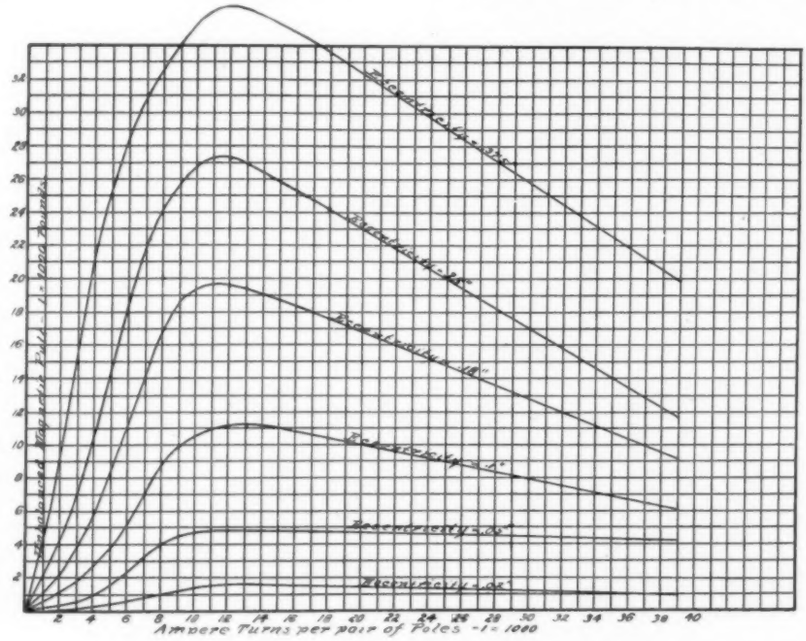

Eccentricity = .08"
Eccentricity = .06"
Eccentricity = .04"
Eccentricity = .02"
Eccentricity = .00"
Unbalanced Magnetic Pull in 1000 Pounds
Ampere Turns per pair of Poles - I = 1000

FIG. 6.—VARIATION OF FORCE WITH AMPERE-TURNS.

Canada's Available Water Power.

According to official estimates made by its Department of the Interior, the available water powers of the Dominion of Canada are capable of developing energy representing more than 25,000,000 horsepower, which if produced from coal would represent a consumption of more than 562 millions of tons per annum, at the rate of 21.9 tons of coal to the horsepower.

The Province of Quebec leads with an available water power of more than 17,000,000 horsepower, its present development of horsepower, however, being only 50,000; whereas, Ontario with a water power of not much in excess of 3,000,000 has a present development of more than 330,000 horsepower.

A New Neon Lamp.

Attention was attracted at a recent meeting of the Academie des Sciences of France to a tube lamp analogous to a Moore tube, but which uses rarified neon as the gas. It glows with an orange-yellow light and seems to be well adapted for practical use, the more so as it is very economical to run.

The Chicago Telephone Company now has nearly 300,000 telephones installed.

CENTRAL-STATION PRACTICE

Transmission—Interior Wiring

ELEMENTS OF POWER-STATION DESIGN.—XIX.

SUBSTATIONS—I.

BY W. B. GUMP.

The function of a substation is to receive electrical energy at high tension from one or more generating stations, convert it to low tension, and finally distribute it through more or less complex networks, to be utilized by a public community or an individual enterprise. The subject to be treated herein will not include substations of the latter class, such as those employed for factory purposes, but will dwell only upon the two classes: lighting and railway. Since the modern lighting plant is expected to supply energy for power also, and a railway plant generally carries a lighting load it becomes evident that the load on a substation is necessarily a mixed load in most cases. The exception is apt to be on the side of the railway plant.

When viewing a prospective market for light or power—of whatever sort—the two leading factors demanding consideration are:

(1) Number of substations.

(2) Location of each.

The first item refers more particularly to railway systems. In large cities both items are difficult of determination.

It is obvious that a large city had its beginning from a village, and prior to that time was not on the map. Therefore, very little of its business, social or economic prospects could be foretold. The demands were met as they appeared, the growth being gradual; when looked upon in their present state we see gigantic power systems made up of apparatus both old and modern, which often renders such a system, as a whole, considerably different from that which would conform to the highest economy.

The foregoing statement leads to the conclusion that the number of substations can only be assumed from the situation actually in hand, since the social and economic conditions are so variable in character as to prohibit an ultimate analysis except by prophecy little less than supernatural.

In the case of railway systems the ultimate length of road is generally fixed and the number of substations settled according to factors discussed hereafter.

Location of Substations.—The location of a substation will in general depend upon:

(a) Center of commercial activity.

(b) Cost of real estate.

(c) Probable direction and extent of growth.

(d) Cost of secondary copper.

As in all engineering undertakings the final decision is a compromise, and must be governed by balancing theoretical considerations against commercial operating requirements. The second factor will in many instances outweigh the other ones, especially in large cities. In the case of interurban railway substations this item is usually less serious.

The third item is one of great importance, and it should be studied most carefully in order to be fortified against deficient service which is likely to result when the demands of consumers reach out beyond the original zone. The alternative is a new substation, located within the nucleus of the outlying district. Here the scheme to be followed will be virtually the same as when designing the first substation, meeting the problem of extension as far as known data will permit.

Item (d) will influence the location to the extent that if the initial investment is limited it may not favor a location which would be governed more especially by future development. Stating the same thing in another way, it may be seen, upon investigation of the conditions—both existing and prospective—that future growth will be too slow to justify a heavy investment at the start; hence provision will be made chiefly for the immediate demands instead of installing larger initial capacity, which will increase interest, maintenance and operation per unit output. It is understood that in all cases the building is sufficiently spacious to install additional machinery when required.

It should be noted here that the capacity of each substation must be adequate to maximum load conditions. The main power station, however, requires a capacity for the average load only.

Railway substations should be located as far apart as is consistent with line losses. In this connection Kelvin's law plays an important part and may be reiterated here. Kelvin's law, briefly stated, is: "The most economical size of conductor is that which has an investment whose annual interest equals the annual cost of the energy wasted." That is, the annual interest and the cost of wasted energy are at a minimum when they equal each other. It has been repeatedly shown in practice that this law has somewhat close limitations beyond which it is not reliable. It has been modified as follows: "The most economical conductor is that for which the annual cost of energy wasted is equal to the annual interest on that portion of capital outlay which is proportional to the weight of metal used."

Due to the fact that commercial factors enter into the question of economy it is seldom possible to express these factors mathematically, and therefore this law generally falls short of determining the result sought. For example, it will often be found that certain standard apparatus is more economical commercially than special appliances which in themselves might reduce the fixed charges. It will be seen further that the fixed charges are constant, while the energy losses exist only when the system is energized. These losses may therefore vary through a wide range. It is therefore clear that the fixed charges continue, once the investment is made, while the energy losses are adjusted according to working conditions.

Increasing the number of substations increases the investment, and hence also the operating expenses, since smaller units are installed for the same total output. Decreasing the number of substations increases the cost of secondary

copper, other factors remaining the same, and also makes regulation more difficult. Where high-tension lines may be extended from one substation to another directly, as is often permissable with railway systems, the primary conductors are simpler and less costly than is the case with substations located at points remote from a direct route. The latter case would apply especially to substations for lighting, while the former is typical of interurban electric railways.

Substation Design.—In designing a substation it is at once evident that the social and economic conditions of the community will have a marked influence on the load curve, and hence the load factor. For example, a railway and lighting plant located in a city which has theaters and amusement parks differs widely from that of a farming town whose load is almost entirely lighting. It is plain that the former will have a better average load factor, although the load curve of the lighting plant can generally be improved by encouraging the use of motors. As the applications of the electric motor continue to increase, it is to be expected that electricity on the farm will soon be indispensable. Along with electric motor applications the electric vehicle should be mentioned. Its utility has been restricted on account of the limitations imposed by the storage battery. Two factors, however, are bound to extend the use of the electric vehicles. One is greater efficiency of the storage battery. The other is that the central station is rapidly extending its field, and we may reasonably expect that in the near future practically every town will have its charging station, thus enlarging the zone of the electric vehicle to a degree which is certain to change the present state of these industries.

From the foregoing it will be seen that industrial growth is significant in its relation to central station and substation design. Preliminary engineering with reference to a new station is therefore bound to include a large number of factors which at the outset are impossible of determination. The only method of dealing with the treatment of this problem is to generalize, basing all statements entirely on fundamentals. This will show the features in their broadest sense, and from these we may narrow down to some of the details to be considered. The design will be treated under the following topics:

(a) Method of transformation.
(b) Capacity and number of units.
(c) Selection of apparatus.
(d) High-tension details.
(e) The low-tension side.
(f) The building and appurtenances.
(g) Typical substation.

(a) For lighting alternating current is now most widely used. Some of the older plants are still employing the Edison three-wire direct-current system, but this is at present practically limited to office buildings and private installations.

The exclusive use of alternating current resolves itself into a transformer substation which is necessarily simpler than one requiring direct-current service. From this fact it is quite clear that the receiving station for a long-distance transmission plant should hold to alternating-current distribution as far as the low-tension service will allow. Electric railway practice still favors direct current, on account of which a current rectifier is required, either in the form of a rotary converter or motor-generator. The charging of storage batteries and the operation of direct-current arc lamps require either rotary apparatus or mercury-arc rectifiers.

(b) It was stated that the capacity of a substation must be governed by the maximum demand and not by the average load. This will readily be understood from the fact that a capacity based on normal full load would fail to accommodate extreme overloads, particularly those imposed on rotary apparatus. Considerable latitude is permissable with transformers as to overload, and their efficiency is high over a wide range, as compared to rotaries or motor-generators. Since the efficiency varies with the load in either case the most economical capacity to be installed will have a definite relation to the load curve. In practice, however, the load curve does not admit of accurate determination at the outset, and therefore the first cost and interest charges generally have a more direct influence upon the capacity of the initial installation.

Two complete units should be installed in the beginning and space provided for at least one additional unit. Future development will indicate whether the third unit should be larger than those of the original installation. It is necessary to arrange the switching so that complete interchange may be secured between the units. An exception may be cited in the case of small transformer substations in which the disability of a transformer would not affect a large portion of the system. Continuity of service, however, is often as important with small stations as large ones, and the conditions in hand must be carefully considered in each case.

(c) In selecting apparatus for a substation so much depends upon local conditions that anything like definite rules are impossible. The opinion of engineers varies widely with respect to a fixed set of operating requirements, so that the problem becomes still more complex. Under this heading we may discuss the following items:

(1) Choice of transformers.
(2) Synchronous converters versus motor-generators.
(3) Apparatus for street lighting.
(4) Auxiliary appliances.

The proper choice of transformers may be arrived at most directly by an analysis of the advantages and disadvantages of each type. Transformers may be classified under two general headings—the air-blast and oil-immersed types.

The chief advantages claimed for air-blast transformers are: Simple to install; comparatively small floor space; somewhat higher efficiency than the oil-cooled; wide working range; terminal connections may be placed below and out of view; easier to maintain.

Their chief disadvantages are: High cost; a special foundation is required for ventilation; they are not practical for very high potential.

The preceding items referring to air-blast transformers show the relative advantages of the oil-immersed type. The latter is more extensively used, particularly in large capacities.

Oil-insulated transformers may be (1) water-cooled; (2) forced oil-cooled; (3) self-cooled. Of these three methods the first is the most common in large sizes. Its disadvantages are that a cooling coil is necessary within the case. Both this method and the second require auxiliary apparatus for circulating the water or oil. The second method, however, may eliminate a cooling coil within the case. The third method—that of self-cooling—has the advantage of eliminating all auxiliary appliances, but in large capacities it has the great disadvantage of occupying an excessive amount of space and its cost is about twenty-five per cent higher than the water-cooled type. An abundance of oil is also demanded, and this means increased fire risk. Where the fire risk is augmented, a barrier sys-

tem for isolating the transformers is required. This adds further to the cost of construction and hence enlarges the capital outlay.

The principal reason for adopting self-cooled transformers is the fact that in certain sections of the country the cost of obtaining cooling water is more than offset by the additional first cost of the transformer, the extra space required and the other factors which under normal conditions are unfavorable. Examples of this are to be found in Arizona where the heat in certain seasons is so intense that air-cooled transformers cannot be considered except under comparatively light-load conditions.

Air-blast transformers are well suited to heavy momentary overloads, and are therefore used extensively in railway substations. Outside of this field the air-blast transformer is not generally to be recommended, and is being largely superseded by the oil-insulated type. Above 30,000 volts it is not feasible to consider air-blast transformers, except under special conditions.

In Figs. 1 and 2 typical efficiency curves are shown for transformers, rotaries and motor-generators, respectively.

Synchronous Converters versus Motor-Generators.—Where direct-current distribution is required it becomes necessary to choose between three types of converting or rectifying machinery:

(1) Rotary converters.

(2) Synchronous motor-generators.

(3) Induction motor-generators.

We shall assume that the substation in question is to be operated from a long-distance transmission line. Thus there will be more or less variation in the receiving voltage, even under the best operating conditions.

Synchronous apparatus is sensitive to voltage variation, especially when heavily loaded. The most extreme condition occurs when the line potential drops to zero, either from a short circuit or from some other cause. The effect is to throw the machines out of synchronism, necessitating a complete shutdown before they can be put back in service.

The induction motor-generator set is practically immune from interruption or disturbance relating to incoming voltage fluctuations. One of the greatest disadvantages of the induction motor-generator is its influence on the power factor, which is inherently lower than can be secured through field adjustment of synchronous machines. Hence a large railway system employing induction motor-generators should have a portion of its apparatus in the shape of synchronous machines in order to raise the power factor and improve regulation. Induction motor-generators offer an advantage in that they are much simpler to operate, and therefore do not demand as much skill and close watching.

A very important distinction between rotary converters and motor-generators is brought to view from the fact that the direct-current side of a rotary is controlled by the alternating-current side, while with motor-generators the direct-current side is entirely independent of the alternating-current side. On this account the motor-generator is superior as regards immunity from the effects of varying power factor due to change of load. The power factor may, of course, be altered by means of the shunt-field rheostat, but it is generally impractical to change the field excitation with each change of load, except by a compound winding. Railway convert-

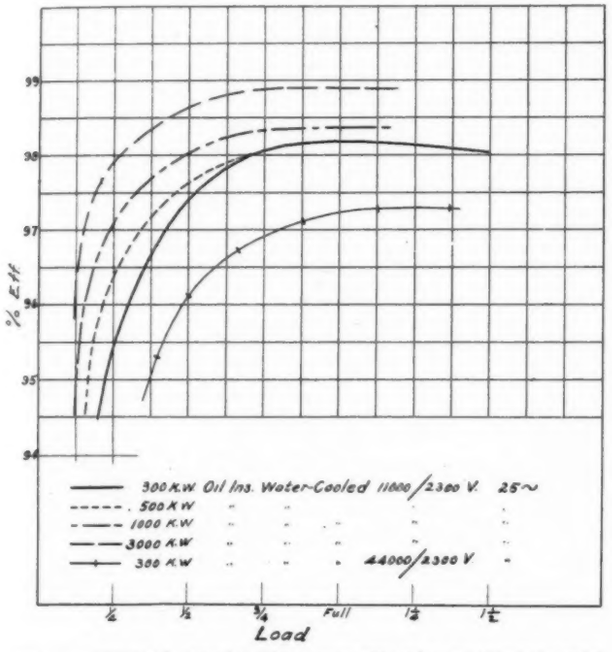


FIG. 1.—TYPICAL EFFICIENCY CURVES FOR TRANSFORMERS.

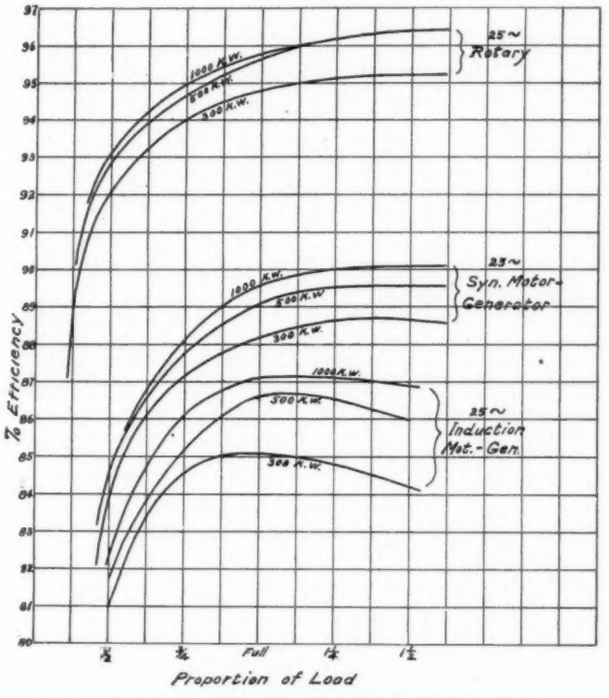


FIG. 2.—TYPICAL ROTARY AND MOTOR-GENERATOR EFFICIENCIES.

A rotary converter has several advantages over a motor-generator, synchronous or otherwise.

First—It is a single machine, and hence offers less likelihood of giving trouble than that presented by two machines—a motor and a generator.

Second—The alternating-current voltage on a rotary converter is usually much lower than is demanded on the motor side of a motor-generator; consequently the insulation strains are less severe.

Third—A rotary does not require the amount of space that is demanded by a motor-generator of the same output.

Fourth—A rotary converter is much cheaper and has a higher efficiency than a motor-generator.

ers are generally compound wound in order to accommodate heavy load fluctuations.

The question of reliability is an important issue and with regard to this it may be said that there is some disagreement. As to breakdowns the rotary converter would seem to have the advantage over a motor-generator, since the former is a single machine. However, the rotary converter and the synchronous motor-generator are both more sensitive in their operation than the induction motor-generator, and are thrown out of commission more easily. This is one of the chief reasons why induction motor-generators are used in many large railway and lighting systems.

Apparatus for Street Lighting.—Substations having a mixed load invariably supply current for street lighting. The most widely used apparatus for alternating-current street arc lighting is the constant-current transformer. The number of outside circuits to be supplied will determine the extent of space needed within the station. Due provision should be made for future installations. The use of magnetite lamps demands direct current, so that mercury-vapor rectifiers are used when the source of supply is entirely alternating current. These rectifiers are contained in oil tanks which require considerable space.

(To be continued.)

[EDITOR'S NOTE.—This important series of articles was started in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, September 3, 1910, and will cover every phase of central-station design. The treatment is elementary and withal practical throughout, and the complete series will constitute a standard and reliable treatise on this important subject.]

Utilization of Water Power in Vancouver.

The province of Vancouver is peculiarly adapted to the comparatively cheap utilization of its water power. A competent authority states that it is safe to say that on Vancouver Island 500,000 horsepower may be cheaply developed within 150 miles of the city of Vancouver, should that amount be required. At Adams River, above Kamloops, is another magnificent power site. On the Kootenay River, near Nelson, is a hydroelectric power plant at Bonnington Falls, installed at a cost of over $350,000, which furnishes power at a maximum of $30 per horsepower per annum for manufacturing purposes. The Pend d'Oreille River, south of Nelson, is also capable of developing some 50,000 horsepower at moderate cost. On the west flank of the Rockies are many smaller power possibilities. On Willow River, within twenty miles of Fort George, a company is now undertaking the development up to some 20,000 horsepower as required. Near Prince Rupert the Katahda River may be made to furnish about 10,000 horsepower. The full extent of the water power of the province will probably largely exceed 1,000,000 horsepower, though at present it is impossible to make an accurate estimate.

Production of Coal in 1909.

The statistics of coal production in the United States as collected jointly by the United States Geological Survey and the Bureau of the Census, show that in 1909 the output amounted to 459,209,073 short tons. Compared with the record for 1908, when the production amounted to 415,842,698 short tons, the record for 1909 shows an increase of 44,039,650 short tons, or ten per cent. All of the gain was in the production of bituminous coal, which increased from 332,573,944 short tons in 1908 to 378,551,024 short tons in 1909—a gain of 45,977,080 short tons. The production of anthracite in Pennsylvania decreased from 83,268,754 short tons in 1908 to 80,658,049 short tons in 1909.

Pennsylvania made the largest increase in the production of bituminous coal, showing a gain of 20,666,288 short tons from 117,179,527 short tons in 1908 to 137,845,815 tons in 1909. West Virginia for the second time in its history exceeded Illinois, and became the second state in the production of coal, the former having an output in 1909 of 51,446,010 short tons, and the latter an output of 50,970,364 short tons. West Virginia's production increased 9,548,167 short tons over 1908. The output of Illinois, which stood third in rank, increased only 3,310,674. Ohio retained its position as fourth in rank with a production in 1909 of 27,919,891 short tons against 26,270,639 in 1908. Indiana, which in 1908 supplanted Alabama as fifth in rank, strengthened its position in 1909 by an increase of 2,566,809 tons, from 12,314,890 tons in 1908 to 14,881,699 tons in 1909, while Alabama gained 2,099,317 tons, from 11,604,593 tons to 13,703,910 tons. Other significant increases were in Colorado, 1,087,773 tons; Wyoming, 890,995 tons; Kansas 734,270 tons; Montana, 640,082 tons; Iowa, 594,052 tons, and Washington, 551,463 tons. Georgia, Idaho, Maryland, Michigan, Missouri and Texas showed decreases.

Byllesby Company Acquires Western Properties.

H. M. Byllesby & Company, Chicago, Ill., has acquired control of a number of additional public utility properties in California, including two important water-power developments and several water-power sites not yet developed. The principal local plants purchased consist of the electric and gas properties formerly owned by the Stockton Gas and Electric Corporation, at Stockton; the electric light and power business at Richmond, and the gas and electric properties at Eureka. The American River Electric Company, which owns a large hydroelectric plant on the American River in Eldorado County, California, and maintains a reserve steam turbine plant at Stockton, is included in the transaction. The Humboldt Gas & Electric Company, operating at Eureka, possesses a considerable water-power development in Trinity County, transmitting current to Eureka, sixty-five miles distant. The American River Electric Company's business includes service to Stockton, Placerville, Florin, Elk Grove, Sheldon, Gault, Lodi and Plymouth by means of long distance transmission lines, which are also extensively utilized for supplying power for gold mining and irrigation purposes.

Eureka and surrounding towns have a population of 22,000. They are located on Humboldt Bay, which affords one of the few good harbors on the Pacific Coast. Back of the city lies an immense area of redwood forests. Eureka will soon be connected with San Francisco by a railroad line now under construction. Stockton with suburbs has a population of 30,000, is one of the oldest cities in California and is a manufacturing center of importance. Richmond, a newer town of 12,000 people, lies on San Francisco Bay south of Berkeley. It, also, is a manufacturing center and is the location of large new shops being built by the Pullman Car Company. All three cities have shown great recent growth. A new company known as the Western States Gas and Electric Company has been formed to hold the stock of the properties described.

ELECTRICAL Advertising *and* Selling

NO COMPLAINT DEPARTMENT.

BY W. B. FOSHAY.

One of the questions that every central-station manager has to face daily is the proper handling, from the public's, as well as his own point of view, of the complaints that every central station is sure to meet with. This work must be done as near to the satisfaction of the public as is possible.

That this question is one of the most important to the welfare of the company, I do not think any one familiar with the proper handling of a public service corporation will dispute, but as to the best method to employ to secure the best results, you will find as many answers and opinions as managers.

The combination of the complaint and business-getting departments is being tried by some progressive operators, and seems to be meeting with a marked success. It seems strange that this plan has not come into general use, and for that matter more strange that it is only now being started in this line of business. All other lines of business have for years put it up to the salesman to see to it that his own trade is taken care of, and the men that you and I like to buy from are those from whom we know are as glad to take up and settle any trouble that may come up, as they are to take our order, and we have no use whatever for the man who, after selling us a big bill of goods, in which some article is not up to standard or not what we ordered, comes in to see us again and when told of our trouble, at once says that he has nothing to do with that end of the business, and for us to write to Jones, Smith or Brown of his company at their office somewhere on the earth, but far away enough to cause us much inconvenience, and tell them our troubles.

Now if it is good business policy for the manufacturer, the merchant and the jobber to follow this plan of having a salesman take care of the complaints of the customer, why would it not be good practice for the public-service corporation? It is, beyond a doubt, and sooner or later we will all have to come to it.

There is another big feature that this method of handling complaints permits, and that is in doing away with the old familiar sign that has for years adorned the most conspicuous place in most every gas or electric office, from coast to coast, "Complaint Department," "Complaints," or "Complaint Clerk." Did you ever consider that such a sign is an advertisement to the public that your business is poorly managed? For if it is well managed, why the necessity of such special arrangements to handle that end of your business?

Suppose that upon entering a grocery store the first thing that meets your eyes was a large sign of brass reading "Complaint Desk." What would be your first thought? Why, the natural one, of course, that the store had so many complaints that it was one of the most important factors of the business, and must be given an important place in the store. But just think it over for a moment, is not that just what you do see upon entering nine-tenths of the offices of public service companies? Yes, you know that such is the case all over the country in our line. And to be real honest in the matter, is it not a fact that if you step in the front door of your own company's office you find just such a sign staring you in the face?

By combining the business getting department with the complaint department, all such signs are done away with, and in the place of such signs are hung signs reading something on this order, "New Business Department —Contracts—Information," and such a sign as this will help to sooth the troubled spirits that find their way regularly to our offices daily. You, yourself, would not feel any better if, on going into a store to take up the matter of some mistake or carelessness of some clerk in that establishment, you were directed to a man with the invitation over his head, "Complaints." No, you would at once proceed to make your call upon him exactly what that invitation read, and the longer you stood there with that sign staring you in the face the stronger you would make your tale of woe.

Then, too, it sounds much better to be directed to the new business department than to the complaint desk. It sounds better to be told that "our solicitor will be sent to see what can be done to adjust matters to your satisfaction," than to be told that "our trouble man will call."

This word "trouble" has become one of the most used words in our line of business, and the sooner that it is relegated to a back shelf, the better off we all will be. Arrange to handle any complaints you may have promptly and in as satisfactory a manner as possible to the man making the complaint, but do not lead the consumer to class the complaint end on a par with the most important end of your business, as most of us invite him to do by placing the "Complaint" sign in as bold and prominent a place as our "Cashier" or "New Business" signs.

Get good solicitors, those who know their business, and put the troubles up to them. Put a man in charge of these men who is tactful and can handle the matters that come up successfully, as well as securing the best results from the shopmen. Try this suggestion out; it will be a great and delightful surprise to you. You will be happier, your entire force will feel the effects of doing away with the old and troublesome complaint department and your consumers will be better taken care of. I do not know of anything that can be done at so small an expense, that will bring as large returns as such a change in your organization. It will work, some of us have tried it and find what a great success it is to us in handling the public and securing a better feeling with them in our dealings all along the line, from the smallest consumer

to the largest. Of all things that are necessary, the most important is to see that the solicitor gets on the complaint at once and that it is settled then, at the time, for once and for all. The combination of these duties, the prompt handling of all matters in these departments, will in short order establish any public service company in the good graces of their consumers.

Electric Cook-Stove Campaign.

The Billings & Eastern Montana Power Company, Billings, Mont., for the past two years, has been conducting an active compaign for the introduction of electric irons, coffee percolators, chafing dishes, heaters, etc., but it was found that, aside from electric irons, less than two per cent of the customers became interested in the appliances.

After a thorough investigation regarding the needs of the average consumer it was decided that what was required to introduce electric cooking was something along practical lines that would eliminate the drudgery and danger of the kitchen from the use of gasoline, kerosene and gas stoves. It was believed that with the electric iron and the washing machine placed in the kitchen it would not be a hard matter to introduce cooking by electricity, provided an efficient stove were available. After investigating the different stoves that had been placed on the market the Hughes electric cook stove was adopted, a number were ordered and an energetic campaign was immediately started. A ready sale was found for the stoves, and at the present time more than one dozen electric cook stoves have been placed and are doing good work, some customers going so far as to remove their coal ranges entirely with the intention of doing their cooking both summer and winter by electricity.

The company made a rate of five cents per kilowatt-hour for cooking under the following conditions: The stove is sold outright and connected by running a separate circuit for cooking. A customer for an electric cook stove is entitled to this same rate of five cents for his electric iron, electric washing machine, and, in fact, any other appliance, provided it is connected to this separate circuit, on which there is a separate meter. There is a minimum charge for this meter of $1 per month in order to protect the business already secured for electric irons. Where there is little current used on percolators, toasters, etc., the electric iron is the principal part of the appliance load of any central station, and, therefore, if any customer should discontinue the use of his stove at any time of the year and yet leave it connected in order to get the rate of five cents on his iron, the $1 minimum would give the same revenue that the central station was getting before the installation of the electric stove.

This kind of a rate also induces the people who have washing machines, electric irons and other appliances to install a stove in order to get the benefit of the five-cent rate, as this rate applies only where there is an electric cook stove installed. The company has found the electric cook stove by far the best means of educating the people and making electricity in the home so popular that customers finally decide that it is an impossibility to get along without it. In fact, the central station can on this ground give a rate for electric cooking leaving a very small margin of profit.

Slogan Sign for Phillipsburg, N. J.

Phillipsburg, N. J., situated on the Delaware River directly opposite the city of Easton, Pa., has, through the courtesy of the Easton Gas & Electric Company, installed a mammoth electric sign in a conspicuous location, overlooking all railroads entering the city, reading, "Phillipsburg, N. J."

This sign was installed by the Easton central station, which supplies the city with electric service, following the erection of a slogan sign in Easton in April, 1909. The encouraging results following the erection of this sign led the citizens of Phillipsburg to decide upon one for their own city.

Minneapolis General Electric Company.

Directors of the Minneapolis General Electric Company have called a meeting of stockholders for January 16 to authorize an increase of $875,000 in the common stock. The additional stock will be offered for subscription pro rata to preferred and common shareholders of record the date upon which the increase is authorized. Proceeds will be applied to financing extensions.

Municipal Advertising and Electrical Advertising.

The reasons why every lighting company should be a booster for the city it supplies, are ably set forth in an advertisement which the Union Light, Heat & Power Company, of Fargo, N. D., recently published in the *Fargo Forum*. The management of the Union Light, Heat & Power Company believes that the lighting company should take the initiative in municipal advertising movements.

Here are some of the paragraphs which appeared in the advertisement in the *Forum*:

"When you tell a stranger that you have good gas and electric service, it helps the city.

"When you tell a prospective citizen that the gas and electric rates are fair, it helps in getting him to come to Fargo.

"And when the man with money to invest here learns that the gas and electric company has the faith and energy to make all necessary improvements and extensions that fact is another boost for Fargo.

"The Union Light & Power Company believes in publicity and believes in co-operative effort.

"It believes that its work is vital and important and a very powerful factor in the development of the community.

"The Company knows that it has many public obligations to perform, and it wants to fulfill these obligations in the most satisfactory manner."

Store-Lighting Campaign.

A unique and attractive folder with a return postal card attached is being distributed by the Philadelphia Electric Company, Philadelphia, Pa., in the interest of store-lighting business. The folder contains many pertinent arguments in favor of well-lighted business establishments.

Public Service Legislation in Minnesota.

Legislative matters concerning electrical matters will be considered in the future by two committees instead of one as in the past. One of the newly-formed bodies will attend to legislation regarding electric railways while the other body will be cornered with telegraph and telephone matters.

Delivery Services That Are Assets.

When a big retail merchant can make his delivery service earn money for him instead of being merely a necessary expense, the way it is done is worth investigation by other merchants. Progressive stores in our largest cities are proving the earning capacity of motor wagons when properly operated in a carefully organized delivery system.

Just a few of the more important recent developments in this direction are given here to indicate the possibilities. Thirty-five motor wagons are owned and operated by R. H. Macy & Company, who conduct one of the largest department stores in New York City. These are housed in the company's own garages and cared for by an experienced and competent superintendent and helpers, who are responsible directly to the management.

The power wagons have load capacities of one and two tons, and not only cover all of Greater New York, but run out into the suburbs, twenty miles or more from the store, to make daily deliveries of purchases. The performance of one of the wagons will show the possibilities of the service. One day it was driven to Morristown, N. J., covering seventy-two miles out and back, uphill and down, over macadamized roads. Forty-five stops were made for deliveries and the machine returned to the store in New York at 9:30 p. m., two hours before a team of horses would return to the stable maintained in Newark, about ten miles nearer Morristown, after serving the same territory.

The wagon is regularly worked fourteen, fifteen or more hours a day, covering the longest and hardest suburban route, and averages from fifty-six to fifty-seven miles a day on one charge. Express service by train is eliminated, deliveries are made more promptly and a larger territory is covered than would be possible in the same time and at the same cost with horses. The natural result is an increase in trade.

The retail dry goods house of Jas. A. Hearn & Company uses more than forty machines of various types and sizes. It also has its own garage and repair shop and hires its own mechanics and drivers. The power wagons are put on the hardest suburban routes, but all start from and return to the store or central garage every day. One of the one-ton-capacity wagons covers the Coney Island route regularly, traveling an average of sixty-three to sixty-seven miles and making an average of 150 stops for deliveries of parcels to residences, sometimes running up to 300 deliveries. It leaves the store at 8 a. m. and gets back to the garage usually about 7 p. m. Unless there are an unusual number of deliveries the driver works alone.

When this route was served with horse wagons, hampers of packages were shipped by express to Bath Beach, about midway of the route, where the wagon received the packages.

Ten three-ton trucks are maintained by the John Wanamaker store in New York, which has one of the most unique and expeditious services in the world. These trucks are unusually capacious and have removable inner bodies or crates mounted on rollers. Each crate fits snugly inside the regular closed body of the truck and completely fills it. Large elevators take the crate to the shipping room on any floor of the store, where the packages for any given section of the city are loaded into it, the operation requiring from one to two hours or more. When filled, the crate, which is on a large hand truck, is taken down, run into the court and shoved into the motor truck. Then it is taken at a speed of twelve to fifteen miles an hour to a substation in Harlem, the Bronx, East New York or South Brooklyn. Here the inner body is withdrawn, an emty one put in its place and the truck immediately returns to the store for another load. Light horse-drawn wagons then distribute the parcels from the substation to residences in the immediate section.

No time is lost by the motor truck at either end of the route in waiting for loads to be made up or removed. Ten to fifteen minutes suffice for withdrawing one crate and substituting another. As many as 3,000 separate parcels have been carried in one load by one of these trucks. They work far into the night, often twenty hours out of twenty-four, and average approximately 115 miles a day. The longest hauls are to Port Chester, twenty-eight miles; to Nyack, thirty miles, and to New Brunswick, N. J., more than thirty miles. On one day before Christmas five loads of merchandise were hauled out to the Bronx station by one of these trucks, and these five loads kept twenty-five route wagons busy with local deliveries throughout the day.

There is only one improvement that can be suggested. That is the use of light motor delivery wagons in place of the horse outfits at the distributing stations. Undoubtedly this has been considered already by the management and will follow in time. As it is, one of the three-ton trucks is able to keep from one dozen to twenty of the horse wagons busy constantly.

Electric Sign Opportunity.

United States Consul Benjamin F. Chase reports that the city of Leeds, England, is lacking in modern electric display signs. There is only one sign of that order. There are many of the stationary-light style, inclosed or open, but the attractive display signs of most progressive cities are not seen. Some American concern might find it profitable to develop this field.

The streets of the business section are somewhat narrow and congested, and when stores are closed are dark and dismal in appearance. The electric lighting system is owned by the municipal corporation, but it does not seem to have sought increased business. The corporation also owns the gas plant, which may explain a continued use of gas where electricity would be more beneficial. The charge for electricity for lighting purposes is eight cents per kilowatt-hour.

The Electric Vehicle and the Horse.

"Strictly speaking, the automobile does not compete with a horse, but with a horse and vehicle," writes Henry Harrison in the issue of *Harper's Weekly* for January 7. As gas, after the introduction of electricity, continued to flourish, so the horse and the automobile supplement each other. "The man who predicts the downfall of the automobile is a fool; the man who denies its great necessity and general adoption for many years is a bigger fool; and the man who predicts the general annihilation of the horse and his vehicle is the greatest fool of all."

The City of Toronto, Canada, is planning to erect a mammoth electric sign, in a conspicuous location, containing the slogan, "Toronto Can—Toronto Will."

ELECTRIC LIGHTING and ILLUMINATING ENGINEERING

THE EFFECT OF WAVE FORM UPON INCANDESCENT LAMPS.[1]

BY MORTON G. LLOYD.

In many applications of alternating electric current, the shape of the wave of applied voltage or of current has a definite influence upon the effects produced. That is to say, these effects depend not only upon the frequency of the fundamental component and the effective value, but are influenced also by the presence of harmonics of higher frequency. In the case of motors, for example, it has been shown to be preferable to have a sine wave of applied voltage, while with transformers the core loss is decreased and the efficiency raised by the utilization of a peaked wave of voltage, which induces a flattened wave of magnetic flux. In apparatus which can be operated with either direct or alternating current, similar differences exist. Arc lamps, for example, give better results with direct than with alternating current.

With incandescent lamps very little appears to have been done, from either the theoretical or the experimental side. The object of this investigation is to determine whether any such effect exists, and it is assumed at the start that the effective voltage is constant, since a definite effective voltage represents the usual condition of operation. A continuous current represents the flattest wave available, it having a form-factor[2] and a crest-factor[3] which are both unity, and it will consequently be convenient to compare this condition with a sine wave. The effect upon candlepower and upon life are to be considered, and it will be shown that candlepower is increased and life decreased by the use of a peaked wave.

The equation

$$\frac{e^2}{rJ} = S\epsilon f(\theta) + Mc\frac{d\theta}{dt}$$

represents the energy relations in the incandescent filament, where

e=instantaneous applied voltage
r=instantaneous resistance
Θ=instantaneous temperature
c=instantaneous specific heat
S=surface of filament
M=mass of filament
ϵ=emissive coefficient
t=time
J=Joule's mechanical equivalent of heat.

f is a function of the temperature which is known for a black body, free from the effects of conduction and convection, but in actual filaments the loss of heat is modified by the latter causes and selective emission requires a modification of f or else that ϵ be regarded as a variable. The solution of the above equation also requires a knowledge of the variation of c and r with the temperature. If all these relations were known, then, with e given as a function of the time, Θ could also be determined as a function of the time. Then, if the relation between candlepower and temperature were accurately known, we should have full information of the candlepower. Unfortunately these relations are not known well enough to afford a solution by this means.

It would suffice if we knew the dependence of the above quantities upon the rate of energy supply necessary to maintain any definite condition, but even this information is not available.

Another method of attacking the problem is to consider the power expended in the lamp, and see whether this will vary with the form of wave. The greatest effect will manifestly be obtained when the frequency is so low or the heat capacity of the filament is so low that a condition of equilibrium may be assumed to exist for each value of the impressed voltage.

As the frequency increases the variations between maximum and minimum candlepower of the filament during a cycle continually decrease, and the lag of maximum candlepower behind maximum voltage becomes greater. This has been shown experimentally by Keilholtz and Branch[4], who measured the instantaneous candlepower at various points throughout the cycle.

The resistance of the filament is a function of its temperature, and therefore of the applied voltage. The simplest assumption to make in regard to it is that the conductance varies according to a sine law, when the voltage is sinusoidal. This is not strictly true, as the variation will not be symmetrical about the maximum, but it will give a first approximation to the truth. We write consequently for the voltage

$$e = A\sin pt = A\sin x$$

and for the conductance

$$g = G + B\sin(2x-\beta)$$

The instantaneous power is $e^2 g$ and the average power is

$$P = \int_0^\pi e^2 g\,dx$$

$$= \int_0^\pi A^2 G\sin^2 x\left(1 + \frac{B}{G}\sin(2x-\beta)\right)dx$$

$$= A^2 G\left(\tfrac{1}{2} + \frac{B}{4G}\sin\beta\right)$$

The first term in the expression for P represents the power on direct voltage of the same effective value. If there be no lag of temperature behind voltage,

$$2x-\beta=0 \text{ when } x=\pi/4$$

in order that the conductance shall have the value G when the voltage has the value 0.7071 A, which is the effective value. Hence

$$\beta = \frac{\pi}{2}$$

In this case

$$P = A^2 G\left(\tfrac{1}{2} + \frac{B}{4G}\right)$$

Positive values of B correspond to

1 Paper presented at meeting of American Physical Society and American Association for Advancement of Science, Minneapolis, December 30, 1910.

2 The form-factor is the ratio of the effective value (square root of mean square) to the average value.

3 The crest-factor is the ratio of the maximum value to the effective value.

4 Electric Journal 3, p. 222; 1906.

materials like carbon, whose conductance increases with the temperature. Negative values of B correspond to metals, whose resistance increases with the temperature. Consequently for a very low frequency, where the lag becomes negligible, a carbon filament takes more power with alternating current than with direct current, while a metal filament takes less power.

As the frequency increases, or if the thickness of the filament and hence its heat capacity be increased, the temperature lags more behind the voltage; β increases and $\sin \beta$ decreases, lessening the effect. When β reaches the value π the power becomes the same as with continuous current. The work of Keilholtz and Branch indicates that this point may be reached under practical working conditions. If the lag be still greater than this, the effect will be reversed.

Fig. 1 shows the various curves when there is no lag. e represents the voltage and e^2 its square. G represents the constant part of the conductance, B_1 the variable part for untreated carbon and B_2 for a metal. The periodicity for both power and conductance is twice as great as for the impressed voltage. It is evident that since e^2 is to be multiplied by the con-

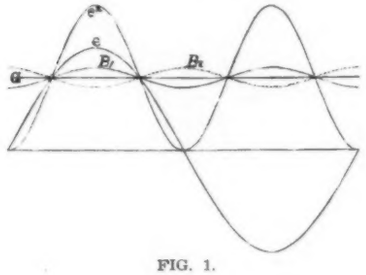


FIG. 1.

ductance, the average product will be greater if the larger values of conductance are coincident with the larger values of e^2, and the average product will be less in the reverse case. It is evident that the shape of the conductance curve need not be regular to give this result; the qualitative effect depends simply upon whether the temperature coefficient is positive or negative.

Fig. 2 illustrates a case of 90 degrees lag in the conductance, corresponding to 45 degrees in the voltage. Here, as before, the power is increased in one quarter-cycle and decreased in the next, but the two effects balance, and evidently from the symmetry it is not material whether the conductance follows curve B_1 or curve B_2. A slight change in the shape of the curve would be sufficient to throw the result on one side or the other.

While the above shows the variation of power with wave-form, it cannot be assumed that the candlepower will vary in the same way. The candlepower depends not only upon the average power supplied, but upon how it is supplied. Since voltage has been

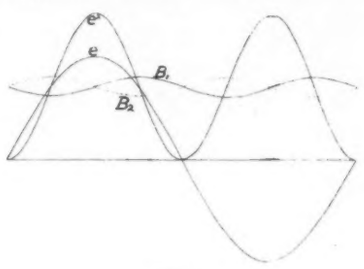


FIG. 2.

chosen as the independent variable, it will be more direct to consider the relation connecting candlepower and voltage. This relation can be expressed by the equation

$$I = h\, E^k$$

The exponent k is not a constant even within working limits for one substance, but according to Cady[5] varies from 3.6 for tungsten at normal efficiency to 7 or 8 for carbon at low efficiency. Throughout the range of ordinary operation it is always greater than three. To obtain the average candlepower during a cycle it is necessary to substitute the value of the variable voltage in the above equation and integrate. Objection may be made made to this computation, since on the threshhold of visibility, k must have a value approaching infinity, while for all values of voltage below this it has the value zero.

It is consequently desirable to express the relation between candlepower and voltage in a different form. The equation

$$I = a\,(e-y) + b\,(e-y)^2 + c\,(e-y)^3$$

where y represents the voltage necessary to just bring the filament to luminosity, represents the curve between candlepower and voltage quite well within the necessary range, if a, b and c are given appropriate values. This equation may be integrated over that part of the cycle in which the filament is luminous to obtain the average candlepower.

$$\begin{aligned} I &= \frac{2}{\pi}\int_{\phi}^{\frac{\pi}{2}}\Big[a\,(e-y) + b\,(e-y)^2 \\ &\qquad + c\,(e-y)^3\Big]dx \\ &= \frac{2}{\pi}\int_{\phi}^{\frac{\pi}{2}}\Big[a\,(A\sin x - y) \\ &\quad + b\,(A\sin x - y)^2 + C(A\sin x - y)^3\Big]dx \\ &= \frac{2}{\pi}\Big[(-ay + by^2 - cy^3)\,\left(\tfrac{\pi}{2}-\phi\right) \\ &\qquad + (a - 2by + 3cy^2)\,A\cos\phi \\ &\qquad + (b - 3cy)\,\frac{A^2}{2}\left(\frac{\pi}{2}-\phi+\sin\phi\cos\phi\right) \\ &\qquad + \frac{cA^3}{3}\cos\phi\,(\sin^2\phi + 2)\Big] \end{aligned}$$

where ϕ represents the value of x corresponding to y. This will give the correct value for the case in which the frequency is so low or the heat capacity so low that a condition of equilibrium may be assumed to exist for each value of the impressed voltage. That is to say, if there be no lag in temperature behind voltage, the quantative result can be worked out. With higher frequencies, the range of candlepower variation will be narrowed and there will be a lag of candlepower behind voltage, but the qualitative result will be the same, the magnitude being greatly lessened.

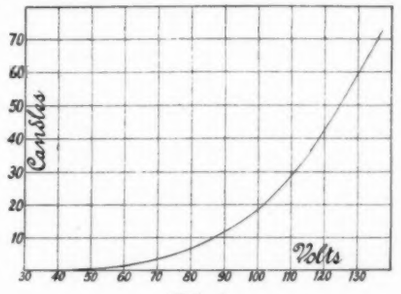


FIG. 3.

Taking the case of the average of 25 Gem lamps given by Marshall[6], and represented in Fig. 3,

$a=0.222$, $b=0.00253$, $c=0.000400$

$y=41.37$, $A=141.42$, $\phi=17.°01$

where one per cent of the normal voltage and of the normal candlepower are taken as units. This average lamp gave sixteen candlepower at 96.7 volts and 2.92 watts per candle.

Inserting these values in the integrated equation we get

$$I = 163.7$$

which corresponds to 26.2 candlepower. This result can be checked by the curve in Fig. 3. Dividing the quarter-

5 F. E. Cady, Transactions Illuminating Engineering Society 3, p. 459, 1908.

cycle into nine parts, and taking from a trigonometric table the values of the ordinates of a sine curve corresponding to the middle of each part, that is, five, fifteen, twenty-five.....seventy-five, and eighty-five degrees, the corresponding voltages are found by multiplying by 1.414×96.7 volts. The corresponding candlepowers may then be read off from the curve of Fig. 3 and averaged, as shown in Table I.

TABLE I.

Angle.	Volts.	Candlepower.
5	....	0.
15	....	0.
25	57.8	1.2
35	78.4	6.0
45	96.7	16.0
55	112.0	31.0
65	123.4	48.0
75	132.1	63.4
85	136.2	70.5
		Average 26.2.

This average agrees with that obtained above.

While such big effects will not be obtained at ordinary working frequencies since the temperature merely fluctuates, the qualitative effect will be the same, and it is evident that, regardless of the power consumption, the average candlepower and hence the total lumen-hours will be greater with sinusoidal than with continuous voltage, and for the same reason, greater with a peaked than with a flat wave.

The effect of wave-form upon the life of a lamp is incidental to the effect upon candlepower. Any effect which increases the average candlepower must involve the attainment of higher temperatures, and it is well known that the life of a lamp decreases rapidly with an increase in temperature. The intermittent application of high temperature may in itself have an effect in the disintegration of the filament, and the application of alternating current is likely to produce indirect results through the medium of mechanical vibrations. Apart from these contributory causes, however, the fact remains that the shortening of life resulting from the high temperature of the maximum is not counterbalanced by the slower rate of depreciation at the minimum.

Marshall[7] gives as the relation between life and candlepower, for all types of lamps,

$$L = \frac{q}{P^{3.66}}$$

where q is a constant depending upon the lamp. This means that life varies inversely as some power of the voltage higher than the tenth. For very low frequency, where the temperature follows the voltage closely, it is evident that the life would be much shortened, since we are concerned with the integral of a power greater than the square. According to Satori[8] this power is about ten for tungsten filaments and about sixteen for carbon.

We may express the ratio of the normal life of a lamp to its actual life by the integral

$$\frac{1}{T}\int \frac{V^z}{V_0^z}\, dt$$

where V_0 is the normal voltage, z is larger than 10, and the integration is extended over a complete cycle T. V is to be expressed as a function of the time, and if its effective value be kept equal to V_0, it is evident that the value of this integral will be larger, the greater the variations in V, that is, the more peaked the wave.

In case the effective current, instead of the effective voltage, is maintained constant, the results can be worked out in a similar manner. This condition would correspond to operation on a series circuit, as is quite common in street lighting. It is found that, for a small lag of temperature behind current, the power consumed in metallic filaments will be greater with alternating than with direct current, while in carbon filaments it will be less. In all filaments the candlepower will be greater with alternating than with direct current, and greater for a peaked than for a flat wave, and there will be a corresponding effect upon the life.

Experimental results for checking the conclusions above reached are very meager. Mr. P. G. Agnew, of the Bureau of Standards, has very kindly made some measurements of the watts with alternating and continuous currents at the same effective voltage, using a precision electrodynamometer. The measurements were made upon a 120-volt, twenty-five-watt Mazda, and a 120-volt, four-candlepower carbon. At twenty-three cycles the tungsten lamp took 0.16 per cent less watts with alternating than with continuous current. With the carbon lamp there was no difference greater than the possible error of measurement, about 0.01 per cent.

I am indebted to Dr. G. W. Middlekauff for a similar comparison of candlepower also made at the Bureau of Standards. With a 116-volt, twenty-five watt, tungsten lamp, used at twenty-five cycles (1.25 watts per candle), the candlepower was 1.6 per cent greater than when used with direct current. With a 114-volt, fifty-watt carbon lamp (3.1 watts per candle), and a 104-volt, fifty-watt Gem (2.5 watts per candle) no difference was observed, although a difference of 0.2 per cent could have been detected with the apparatus, had it existed.

In this connection it should be noted that carbon has a specific heat about six times as great as the heavy metals. Moreover metal filaments, on account of higher conductivity, must be thinner than carbon filaments for the same voltage and candlepower.

Prof. C. L. Kinsloe[9] has found a higher candlepower for all types of lamps when used with a sine wave than when used with a peaked wave at sixty cycles, but the measurements were made upon different groups and not upon the same lamps. The differences are as great as one candle in sixteen, and it would seem that the effects must be due to some other cause than the nominal one.

Kinsloe found the life to be much shorter with a peak wave, but it is questionable whether his other conditions were identical. In tests carried on at the University of Illinois Engineering Experiment Station by Amrine and Guell,[10] tungsten lamps showed a shorter life on alternating currents, but the mechanical conditions probably had more to do with this than the electrical conditions.

It is probable that with metal-filament lamps at sixty cycles or higher frequency, no observable differences will be found, and with carbon lamps the frequency may be reduced to twenty-five cycles or less without making the effects appreciable. Since tungsten-filament lamps show a reduced wattage, but a higher average candlepower, at twenty-five cycles than with direct current, it is not to be doubted that, under proper test conditions, their life would also be found shorter.

6 J. T. Marshall, Trans. Ill. Eng. Soc. 3, p. 477; 1908.

7 J. T. Marshall, *loc. cit.*

8 K. Satori. Electrotechnik u. Maschinenbau 27, p. 227; 1909.

9 Bull. Pa. State College 1, p. 8; 1910.

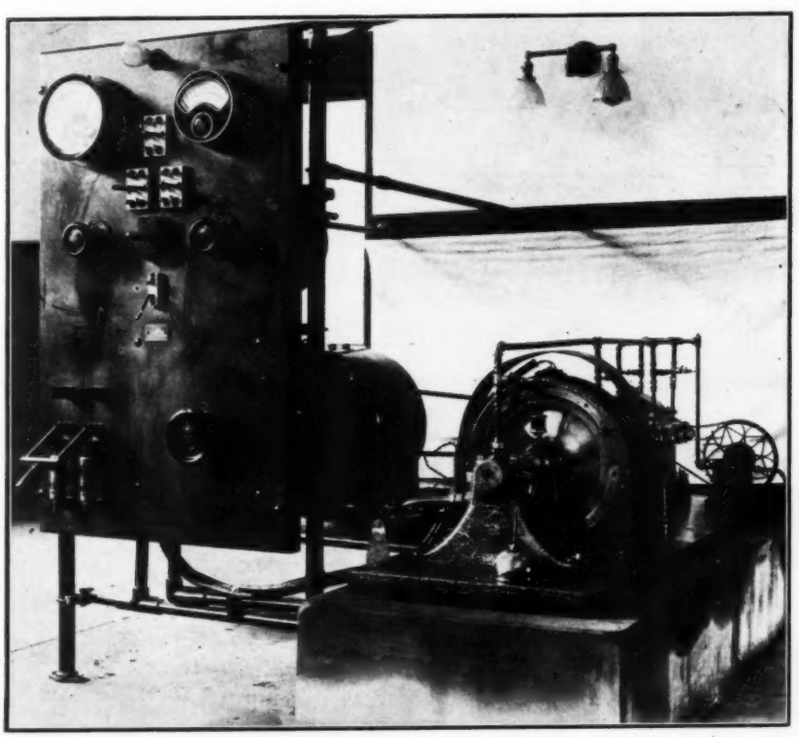
10 T. H. Amrine and A. Guell, Bull. No. 33.

TELEPHONY—TELEGRAPHY, *and* WIRELESS.

A SYSTEM OF MULTIPLEX TELEPHONY.

AN IMPORTANT TELEPHONE INVENTION.

The multiplex signaling system invented by Major George Owen Squier, U. S. Army, and dedicated to the public, is the greatest advance made in electrical communication since the introduction of the telephone itself. No new or especially designed apparatus is required; and yet the invention permits of simultaneous transmission over the same wire of a number of telegraph and telephone messages, which is limited only by the number of frequencies to which oscillating circuits may be tuned. The necessity for using a return wire in telephone circuits is obviated by employing condensers of very small electrical dimensions, which offer great impedance to external disturbances whose frequencies lie within the limits of audibility.



HIGH-FREQUENCY GENERATOR.

In the whole range of electromagnetic waves, which may be looked upon as a spectrum extending from the ultra-violet rays to the exceedingly slow oscillations used in long submarine cables, use has been made of all parts with the exception of two well defined intervals, one extending from a frequency of about 3×10^{12} of the extreme infra-red, to 5×10^{10}, which are the shortest electromagnetic waves yet produced by electrical apparatus, and another interval extending from about 100,000 cycles per second to about 15,000 or 20,000 cycles per second. It is in this latter range, a practically unexplored field, that Major Squier has found the solution for problems of multiplex telegraphy and telephony. The limit of audibility being a physiological function, must vary considerably; but is generally in the neighborhood of from 15,000 to 20,000 cycles per second. By employing frequencies outside the limits of audition as the vehicle for transmitting messages, much after the fashion in which sustained oscillations are used in wireless telephony, a new system of multiplex telephony has been evolved.

With such frequencies as are used in ordinary battery telephony the phenomenon of skin effect is comparatively small and the current is fairly well distributed throughout the cross-section of the conductor. As the frequency increases the skin effect becomes more pronounced and the energy appears less in the conductor and more and more in the ether surrounding the conductor. For this reason the battery telephone current is largely a conduction current through metal, and the resistance of the wire is one of the principal elements limiting long-distance telephony at the present time. On the other hand, commercial wireless telegraphy employs frequencies ranging from 100,000 to several millions, and the impressed energy is chiefly radiated into the ether. In the intermediate range between 20,000 and 100,000, though the energy is carried chiefly by the surrounding ether, it is still sufficiently linked to the conductor to prevent excessive radiation. The conductor, while receiving but a small part of the energy at its surface, nevertheless acts as an efficient guide for the high-frequency electromagnetic waves.

As the amperage used by Major Squier is very low, there are no heating effects to overcome, such as those encountered in the development of the wireless telephone transmitter. The instruments used are those of the ordinary telephone. In some minor instances, however, small changes have been made, among which may be mentioned the use of condensers whose capacities are of the order of thou-

sandths of a microfarad, and inductances of millihenries, to take the place of the ordinary telephone condensers of several microfarads' capacity.

Since any number of high-frequency waves of different periods may be impressed on the same line and selectively separated from each other by suitably tuned receiving circuits, multiplex telephony in a very simple form has been accomplished in a circuit as described. For the same reasons, high-frequency waves may be used on the line with ordinary battery telephone circuits and a telegraph system may operate over the same wire. Also, such harmful effects as "cross talk" may be eliminated at pleasure.

It has been found necessary in order to obtain good results to make use of such detectors as are commonly found in wireless-telephone outfits. They are not employed because of any greater sensitiveness to electrical energy than resides in the telephone receiver itself, but because the energy being in the form of extremely rapid oscillations, cannot affect the telephone or other indicating device. Such rapid oscillations will not sensibly affect the telephone because the diaphragm must reverse its motions with the reversal of the current, and the frequency is higher that any to which the diaphragm can respond. Even were such mechanical vibration possible, the effect would be inaudible. Also, in the case of the ordinary telephone, on account of the large self-inductance of the instrument, the high-frequency electromotive force generated by the waves could produce in the receiver only extremely weak currents. An integrating detector, there, is necessary to transform the rapid oscillations into effects which will be made manifest by the receiving instrument. Although any of the detectors used in radio-telegraphy will give satisfactory results, Major Squier has found that the audion or perikon types are generally the best.

Fig. 1 shows a common metallic circuit for ordinary telephony, across which are bridged the ordinary telephone sets *B* and *B*.' These comprise the apparatus usual in telephone circuits, there being shown a microphone transmitter, 1, with its local battery, 2, and the primary of the transformer, 3. Connected in the usual way are the ringing circuit, 4, and the switchhook, 5, with its receiver, 6. The secondary of the transformer, 3, is bridged directly across the line wires, *A* and *A*,' when the receiver is off the hook. Bridged also across the line wires at the same terminals, or at any convenient distance from them, is the circuit containing a variable inductance, *L*; variable capacity, *C*; and the secondary, *S*, of a transformer whose primary, *P*, is in series with a high-frequency generator of oscil-

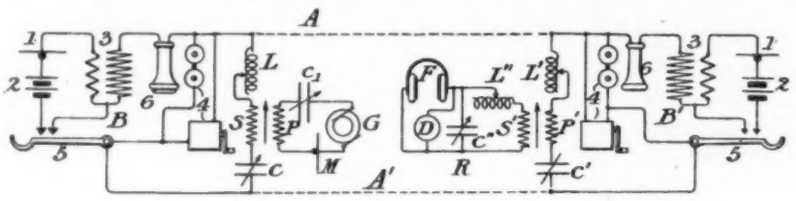


FIG. 1.

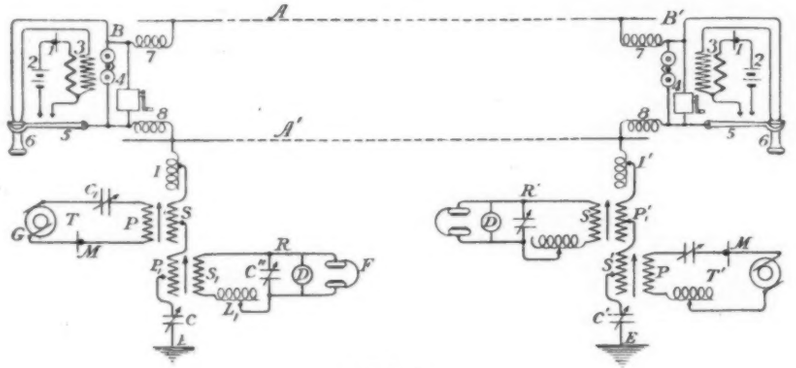


FIG. 2.

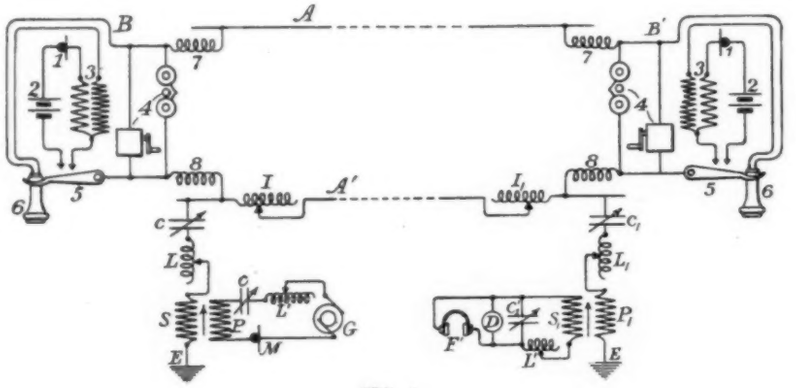


FIG. 3.

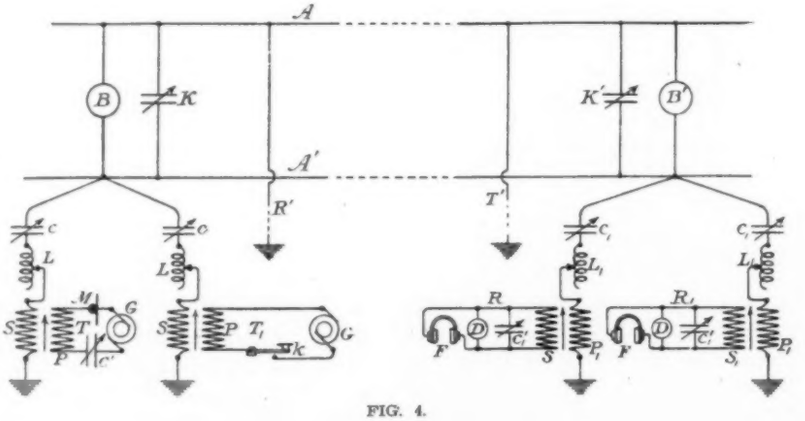


FIG. 4.

lations, G. In this circuit is also included a variable capacity, C_1, and a suitable telephone transmitter, such as the microphone M. The transformer is so constructed as to be variable in its coupling.

At the receiving end of the line there is bridged a similar circuit containing the variable inductance L' and variable condenser C', and the primary, P', of a transformer. The secondary, S', of this transformer is connected in series with a variable inductance, L'', and a variable capacity, C''. Around the condenser is shunted a detector, D, which is connected in the usual way with the telephone receiver as shown at F.

High-frequency oscillations developed by the generator are impressed on the bridge circuit containing the inductance L and the capacity C. These oscillations travel along the line wires and are received at R in the oscillatory circuit L'' C''. When modified in any suitable manner, an effect is immediately produced in the receiver by the oscillations so modified. The microphone transmitter is used to produce on the sustained oscillations of high frequency slight modifications of amplitude of comparatively slow period, but corresponding in every detail to the impressed voice vibrations.

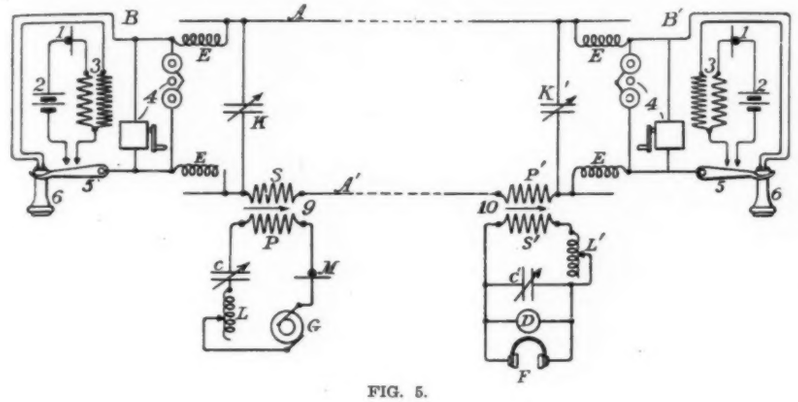


FIG. 5.

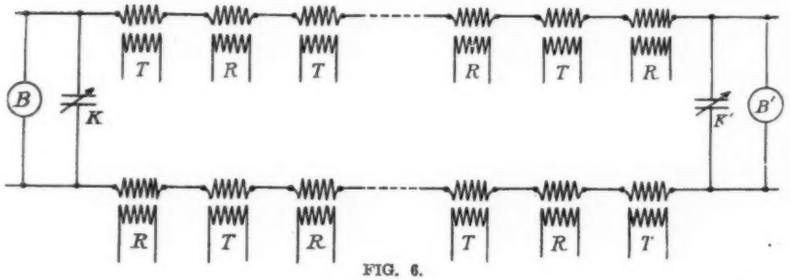


FIG. 6.

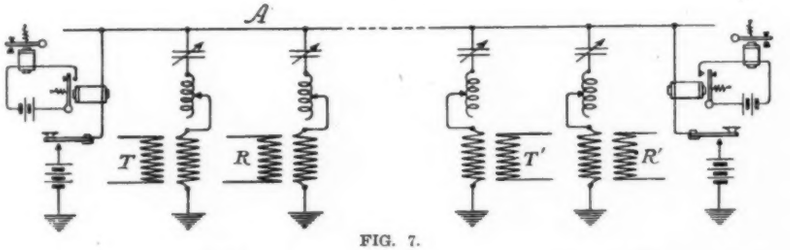


FIG. 7.

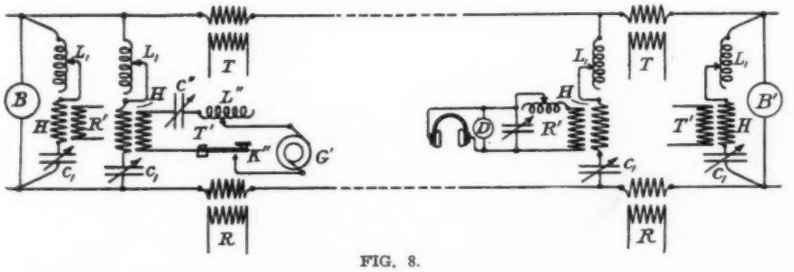


FIG. 8.

Any ordinary telephonic currents transmitted by the sets B and B' will travel over the line wires at the same time as the high-frequency currents, but they will in no way be influenced by, nor will they exert any sensible influence upon, the high-frequency currents. In practice the circuit containing the line and bridges is tuned to the frequency of the generator by means of the variable capacities and inductances. The capacities will also prevent the passage of any telephonic currents from the sets B and B' through the high-frequency bridge circuits, for these condensers are of exceedingly small electrical dimensions and impose too large an impedance for currents of ordinary telephonic frequency, while they offer very low impedance to currents whose periods are in excess of 20,000 per second.

So far, only circuits in parallel with the line wires have been considered,

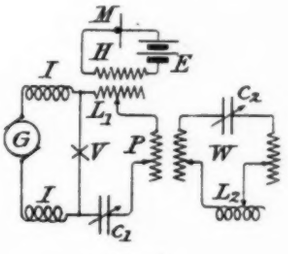


FIG. 9.

but Major Squier has also had success in operating a multiplex system in series, as shown in Fig. 2. A form of the system in which earth return takes the place of the second line wire is shown in Figs. 3 and 4, the latter indicating the manner in which a plurality of high-frequency stations is connected for simultaneous use over the same wire and earth return. Figs. 5 and 6 show the system as installed with generators in series instead of being bridged across the line wires. In Figs. 4 and 6 the telephone sets are not shown in detail, but indicated diagrammatically at B and B'. Multiplex high-frequency telegraphy is shown in Fig. 7, and the simultaneous use of the telegraph and telephone over the same earth-return circuit in Fig. 8.

Although such sources of oscillations as the Duddell arc have been employed with success in this system, as indicated in Fig. 9, Major Squier relies princi-

pally upon the remarkable performance of a special generator, which was constructed for him by the General Electric Company and is shown on page 97. The oscillations are obtained from the generator direct. The output of this machine is only two kilowatts, but the frequency is 100,000 cycles per second. The attainment of this result involves the use of a rotor about one foot in diameter geared up to a speed of 20,000 revolutions per minute. The generator produces approximately pure sine waves, which are sustained in amplitude and correspond to a wave-length of 1.86 miles.

Two Telephonic Messages Sent Simultaneously Over a Single Circuit Without Interference in Chicago Over Two Years Ago.

An interesting commentary on the announcement of Major Squier's discovery of multiplex telephony is the statement issued by Frank L. Perry, a well known electrical man, of Chicago, Ill. Mr. Perry has submitted a statement made by Donald M. Carter, patent lawyer, a member of the firm of Parker & Carter, of Chicago, announcing that more than two years ago at Mr. Perry's laboratory in Chicago there was exhibited an electrical telephonic apparatus and system by means of which two telephonic messages were transmitted simultaneously, without interfering with each other, over a single-wire, grounded circuit, and also over a single metallic circuit. Mr. Carter states that both he and his partner, Mr. Parker, carefully examined this apparatus while it was in operation and proved to their own satisfaction that Mr. Perry had successfully solved the problem of the simultaneous transmission of two telephonic messages over the same circuit and without interfering with each other.

Mr. Perry substantiates his claim to having discovered a means for successfully sending simultaneously two telephonic messages (voice transmission) over a telephone circuit by a letter signed by Bion J. Arnold, the well known engineer, of Chicago, who witnessed this demonstration and examined this system on November 4, 1908.

In view of the importance of this announcement, Mr. Perry has carefully analyzed the above-mentioned communication from Mr. Arnold, and during the present week has received from Mr. Arnold another letter. Among other things, Mr. Arnold says: "In order that there shall be no misunderstanding, I wish to state that what I meant to convey by that letter was, that on November 4, 1908, you successfully, during the same period of time, transmitted two telephonic messages in one direction over the same circuit, apparently without any interference. One of these telephonic messages was an ordinary 'to and fro' telephonic message, a conversation between two parties, one at each end of the line, these parties talking alternately, while the other message, during this same period of time, was a transmission of another voice in one direction only, over this same circuit, to a listener, that listener some of the time being myself."

Mr. Perry has not revealed the character of his apparatus or system, so that it is not possible at this time to make any comparison of the underlying features of his discovery with those just announced by Major Squier.

Improvements in Transmitters and Receivers for Wireless Telegraphy.

At the Physical Society's annual exhibition, held in London on December 20, Prof. J. A. Fleming gave a short experimental discourse on this subject, both in the afternoon and evening. He referred first to his oscillation valve detector in which a glow lamp was used containing a metal plate of some convenient form. Owing to the unidirectional conductivity in a bulb when the filament was glowing, current could flow from the filament to the plate, but not in the reverse direction. Fortunately this property held equally for high-frequency oscillations and thus the device could be used as a detector in wireless telegraphy. In the latest form of valve a tungsten filament was used instead of a carbon filament. Owing to the form of the curve connecting potential with current in the vacuous space it was possible to increase the sensitiveness very materially by applying to this detector a constant electromotive force on which the electromotive force of the oscillations was superimposed.

Passing on to the oscillations and methods of producing them, Professor Fleming laid stress upon the fact that the effect varied with the method of production. Thus if the spark gap was subjected to an air blast the secondary current was increased. This was due to the fact that the ordinary spark consisted of an arc discharge and a spark discharge superimposed. The former lowered the voltage available for charging the condenser and therefore it was desirable to remove it. This was done by means of the air blast. In order to see just what happened it was necessary to count the sparks produced, and a photographic spark counter was used for this purpose. Records were reproduced and showed that much greater regularity was obtained with the air blast than without it.

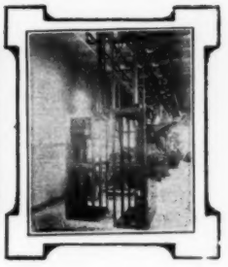
Professor Fleming finally described a new form of discharger which he had recently designed. This was of the quenched-spark type, and consisted essentially of two steel plates, one above the other, the lower one being stationary, and the upper one in rotation. The plates, which were very perfectly surfaced and spaced one-quarter millimeter apart, were immersed in oil, and as there was a small hole in the center of the bottom plate a continuous circulation of the oil took place when the upper plate was in rotation. This form of spark discharger was shown to give exceedingly uniform results, and it had been used by the lecturer for the purpose of measuring condenser losses.—*Electrician*, London, December 23, 1910.

Wireless Engineering at Michigan University.

At the University of Michigan wireless engineering is taught as a distinct branch of engineering work and the students have the use of a complete set of laboratory apparatus as well as sending and receiving stations. Different forms of antennae and different types of detectors are tested, and the influence of varying heights, and sizes of materials, and varying conditions of weather investigated. Among the problems being dealt with is the influence of light and darkness upon the efficiency of wireless transmission.

At the eighth annual convention of the representatives of independent telephone companies of Kentucky, held recently at Louisville, it was decided to organize a state body, and to incorporate under the name of the Kentucky Telephone Traffic Association.

Industrial Power



CONTROL OF ELECTRIC WINDING AND HOISTING ENGINES.[1]

BY E. ROSENBERG.

Electric winding has been proven a distinct economic success. In many cases it is not only the cheapest in working, but also in first cost. Among its advantages are ease and safety of control, the entire absence of jerks, and the perfect regularity of drive from full to creeping speed.

The direct-current motor and the polyphase induction motor have generally been used for electric winding engines of large capacity, and only these will be considered. Single-phase commutator motors could be used, but are expensive, and not so efficient as the other motors. Single-phase induction motors present difficulties of control, and, therefore, will rarely be used for direct driving of large winding engines.

As far as the control of direct-current and polyphase induction motors is concerned, we have mainly to distinguish between rheostatic control used for either type of motor, and Ward-Leonard control used only for direct-current motors, for which a special controlling generator is employed. The rheostatic control, that is, the starting from a substantially constant busbar voltage by the insertion of a gradually decreasing resistance, inserted either in the armature circuit of a direct-current motor, or in the rotor circuit of an induction motor, can be done either with metallic or liquid resistances. For large motors, and nearly always for induction motors, liquid controllers are employed.

Ward-Leonard control requires a special direct-current generator either engine-driven or, more often, driven by an electric motor supplied with current of constant voltage (either alternate current or direct current) from general busbars. The generator part is a direct-current generator with separate excitation, which can be changed between the limits of zero and a positive and negative maximum. The winding motor is externally constant-excited, and its armature is connected to the generator armature without any switches or controller. The speed of the winding motor is, therefore, in approximate proportion to the voltage of the controlling generator, and the direction of rotation is directly dependent upon the direction of the exciting current of the generator. A small shunt controller gives perfect control over the whole machine.

The Ward-Leonard system gives wonderful ease of control, and very light and simple controlling apparatus; the amount of machinery, however, is increased, as are the initial costs, and the great advantage of practically negligible starting losses is partly counterbalanced by the loss of efficiency in the motor-generator. As far as current consumption is concerned, the Ward-Leonard system will show to great advantage if starting and braking periods are of comparatively long duration, and winding intervals short, also if trips with reduced speed are of frequent occurrence; whereas the straight rheostatic control will show up best if full-speed runs and winding intervals represent a very great portion of the whole working time.

Very often it is considered essential to guard against interruptions of the supply, and to provide means which would enable the continuation of at least one trip. The Ward-Leonard system lends itself very nicely to a storage of energy by coupling with the motor-generator a flywheel (Ilgner system). This also allows of equalizing the demand on the power station by providing the motor of the Ilgner set with a considerable drop in speed between no load and overload, and thus giving the flywheel an opportunity to discharge a part of the stored energy when the load grows, and to store energy between the periods of work. Instead of the flywheel, a direct-current generator can be used, which is parallel with a storage battery.

We have always to reduce the speed at the end of a trip and to bring the winding engine to a standstill, but very often we have also to lower unbalanced loads instead of lifting them, and in this case the winding motor has to work as a generator converting mechanical energy into electrical. In many cases the change from positive to negative motor torque will occur during each trip.

As long as the speed of the Ward-Leonard motor-generator is kept constant, the shunt regulator of the controlling direct-current generator determines fully the electromotive force of the controlling machine, and if the winding motor is mechanically driven from outside, the speed of the constantly excited winding motor will attain a value which gives an electromotive force in the winding motor only slightly higher than that of the controlling machine, because already a slight difference will give rise to a circulating current of sufficient magnitude to balance the torque impressed from outside.

Assuming that the exciting voltage is kept constant, that there is no flywheel and no artificial slip in the motor-generator, that the primary frequency and voltage remain constant, the difference of the motor speed between no-load torque and full-load torque due to all causes combined will be approximately 12 per cent, if the induction motor has only two-per-cent slip. If the winding motor has to exercise a negative torque of half the value of the normal working torque, the difference in speed will grow to eighteen per cent. For half excitation the lifting speed for normal load will be about thirty-nine per cent of the full (no-load) speed and the lowering speed for a load which would require half-

[1] Abstract of a paper presented at a meeting of the Institution of Electrical Engineers, Manchester, December 6, 1910.

braking torque will be about fifty-six per cent of the full speed.

In the case of using the motor as a brake if rheostatic control is employed, the motor being a direct-current shunt motor fed from direct-current busbars, the motor can be built for combined series and shunt regulations. This reduces the rheostatic losses in starting, as the speed regulation effected by the shunt regulator is done without loss. For all speeds within the range of shunt regulation braking is done most effectively without any additional apparatus, because the motor, if its armature is connected to the busbars without intermediate resistances, will work as a generator if driven from outside and return power to the line.

The regenerative control cannot be used to slow down the motor at the end of the trip. For this, either the controller has to be moved quickly into the "off" position and the mechanical brake applied, or the controller may be quickly moved beyond the "off" position and the first steps for the reversed movement used, which allow outside current to enter into the motor in such a direction as would be needed for lifting the load which is being lowered.

With a polyphase induction motor used as a winding motor, the conditions are exactly analogous to those of a direct-current shunt motor (without shunt regulator) fed from busbars. If the rotor is short-circuited, the machine will, for a slight increase in speed, act as an induction generator and return power to the line.

We can disconnect the armature of a direct-current motor from the line and connect it either to a part of the resistance of the starting controller or to another resistance. If the machine is constantly excited from the busbars, the braking torque or braking current will be in direct proportion to the speed of the motor, and in inverse proportion to the controller resistance; therefore, in order to keep perfect electrical control of a constant lowering load from the start up to the very end of the trip, it would be necessary at first to increase, then to reduce the outside resistance gradually in proportion to the desired momentary speed.

Here we have the same peculiarity as with all other braking methods where a resistance in the armature is applied, that an increase of this resistance increases the speed of lowering, whereas, for the motor working as a motor, an increase of resistance reduces the speed.

This is entirely different in an induction motor, a part of which is excited by direct current (either the rotor or stator) and the other part connected to a resistance. As a rule, the stator, which is normally wound for high-voltage alternating current, will be connected to a low-voltage direct-current supply and the three slip-rings of the rotor connected to a resistance of the corresponding number of phases. Such a machine represents an alternating-current generator with stationary field, the exciting winding of which is distributed in the slots, and with a rotating polyphase armature connected to ohmic resistances. The frequency of the generator will, of course, vary according to the speed, and would be equal to the supply frequency if the rotor were rotating at full motor speed. If the stator is excited with the equivalent value of the full-load stator current and the rotor rotating at normal speed and giving a voltage equal to the open-circuit rotor voltage and a current equal to full-load rotor current, then it will be found that the ampere-turns on the stator are only a few per cent in excess of the rotor ampere-turns, whereas, in an ordinary alternating-current generator, the field ampere-turns are generally twice as much as the full-load armature ampere-turns. The big armature reaction has a very important bearing on the behavior of the machine, because it is only for comparatively small armature reaction that it can be said that at constant speed the torque will be in nearly inverse proportion to the outside resistance. As soon as the armature current exceeds a certain limit a reduction of the outside resistance will not only not increase, but even reduce, the braking torque, because a slight increase in armature current is accompanied by a more than proportionate reduction in field strength. With short-circuited slip-rings the torque obtainable at higher speeds is very small.

In a star-wound machine, with terminal No. 1 connected to the negative direct-current supply, terminals Nos. 2 and 3 in parallel connected to the positive supply, the current in phase 1 will have the double value and opposite direction of the current in phases 2 and 3. In this connection the direct current replacing the three-phase excitation will have to be of the value of 1.414 times the alternating current in one phase.

If only two of the three terminals are connected to the direct-current supply, the equivalent direct current will be twenty-three per cent higher than the alternating current. Exactly the same holds good for delta connection.

Using the motor itself as a brake with direct-current excitation renders it impossible to use, at the same time, the combined effort of the brake and the motor, and it requires some special switching arrangement for stator as well as rotor. The stator winding must be connected to a controller which allows three different connections: (1) alternating busbars, forward movement; (2) alternating busbars, backward movement; (3) direct-current busbars for braking. Also for the rotor, if ordinarily a liquid starter is used for motoring, a switching arrangement will be necessary to throw a metallic braking resistance on to the slip-rings.

From the test curves published for eddy-current brakes with copper disks, and from experiments made by myself on eddy-current brakes with cast-iron armatures, I believe that an essential difference exists between the two. In the brakes with copper disks for constant excitation, the torque at first increases with the speed, but falls after a critical speed is reached. An eddy-current brake like this, used for winding engines, would have very serious disadvantages, at least if the critical speed could not be shifted to a very high value.

With eddy-current brakes with cast-iron armature I was never able to find a reduction in torque with increase in speed, but, on the contrary, a steady increase. The power absorbed by the brake increases at first nearly in proportion to the square of the speed, and even with high frequencies it is still more than proportional to the speed, even up to a frequency of the brake armature current as high as 130 cycles per second.

The cast-iron armature has, besides great simplicity, rigidity and cheapness, the advantage that the specific resistance of the material is aproximately forty times greater than that of warm copper.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

MEXICAN TELEGRAPH.

The report of the Mexican Telegraph Company for the quarter ended December 31 (partly estimated) compares as follows:

	1910	1909
Gross	$ 205,000	$ 195,000
Expenses	37,500	37,500
Net	167,500	157,500
Other income	24,500	25,000
Total income	192,000	182,500
Mexican government	9,500	8,000
Balance	182,500	174,500
Dividends	89,735	89,735
Surplus	92,765	84,765
Previous surplus	2,479,757	2,192,127
Total surplus	2,572,522	2,276,892

CENTRAL & SOUTH AMERICAN TELEGRAPH.

The report of the Central & South American Telegraph Company for the quarter ended December 31 (partly estimated) compares as follows:

	1910	1909
Gross	$ 435,500	$ 445,500
Expenses	165,000	167,000
Net	270,500	278,500
Other income	1,250	5,200
Total income	271,750	283,700
Dividends	143,565	143,565
Surplus	128,185	140,135
Previous surplus	2,121,293	1,634,958
Total surplus	2,249,478	1,775,093

PACIFIC TELEPHONE AND TELEGRAPH.

The Pacific Telephone and Telegraph Company reports for the ten months ended October 31, 1910, compared as follows:

	1910	1909
Gross	$11,535,066	$10,029,272
Expenses	9,011,960	7,091,865
Net	2,523,106	2,937,407

EDISON ELECTRIC ILLUMINATING OF BOSTON.

The report of the Edison Electric Illuminating Company of Boston for the month of November and five months ended November 30, compares as follows:

	1910	1909
November gross	$ 485,156	$ 456,089
Expenses	197,909	183,771
November net	287,247	272,318
Five months' gross	1,943,776	1,732,410
Expenses	877,597	829,023
Five months' net	1,066,179	903,387

DETROIT UNITED RAILWAY.

The report of the Detroit United Railway Company for the month of November and eleven months ended November 30, compares as follows:

	1910	1909
November gross	$ 739,982	$ 676,482
Expenses	478,304	440,750
November net	261,678	235,732
Other income	14,942	10,611
Total income	276,620	246,343
Charges, taxes	174,312	157,919
November surplus	102,308	88,424
Eleven months' gross	8,577,416	7,351,390
Expenses	5,486,787	4,614,783
Eleven months' net	3,090,629	2,736,607
Other income	140,598	132,134
Total income	3,231,227	2,868,741
Charges and taxes	1,863,862	1,723,399
Eleven months' surplus	1,367,365	1,145,342

NEW YORK TRACTIONS.

The New York Public Service Commission has issued the following statement showing the earnings of the principal New York traction lines for the month of September, as follows:

	Tot. St. Rwy. oper. rev.	Net rev. from oper.	Total income.	‡Surplus after chgs.
Hud. & Man.	$ 200,615	$ 97,014	$171,706	*$19,889
Interboro:				
Subway	1,023,183	587,404	615,295	218,463
Elevated	1,240,396	585,482	587,067	101,125
B. R. T. syst.	1,882,376	741,448	777,115	251,261
†Metrop. St.	1,188,973	372,684	388,256	170,107
C. Pk. N. & E.	56,001	9,552	9,552	8,612
†Second Ave.	82,267	20,161	20,161	11,221
†Third Ave.	293,945	132,092	132,186	98,350
†Dry D. E. B.	52,189	9,791	9,791	1,402
†42d St. Man.	132,561	45,905	45,905	34,929
N. Y. Cy. Inter.	21,392	4,368	4,506	*3,413
†Union	203,076	50,466	50,482	32,096
†Westchester.	50,407	10,521	10,612	7,026
†Yonkers	58,744	20,321	20,321	10,972
N. Y. & Q. Co.	106,981	17,393	17,205	*3,753
Other cos.	205,097	73,008	89,081	49,209
Con. Isl. & Bk.	145,724	53,696	53,702	29,567

*Deficit. †Operated by receivers.
‡Interest permanently defaulted is not deducted.

INTERBOROUGH RAPID TRANSIT.

The earnings of the Interborough Rapid Transit Company for the month of November and five months ended November 30 compare as follows:

	1910	1909
November:		
Gross operating revenue	$ 2,558,279	$ 2,459,767
Operating expenses	984,727	887,071
Net operating revenue	1,573,553	1,572,698
Taxes	154,799	124,468
Income from operation	1,418,754	1,488,230
Other income	29,323	31,707
Total income	1,448,077	1,479,936
Int., rent, etc., includ. Manhat. guar.	886,445	881,070
Net corporate income	561,631	598,866
Passengers carried	49,738,841	47,758,158
July 1 to Nov. 30:		
Gross operating revenue	11,526,299	11,283,758
Operating expenses	4,712,245	4,339,068
Net operating revenue	6,814,054	6,944,689
Taxes	766,670	707,503
Income from operation	6,047,384	6,237,186
Non-operating income	147,126	196,722
Gross income	6,194,510	6,433,909
Int., rent, etc., includ. Manhat. guar.	4,444,415	4,389,091
Net corporate income	1,750,095	2,044,817
Dividends (3 months)	787,500	787,500
Surplus	962,595	1,257,317
Passengers carried	223,529,639	219,053,417

The increase in operating expenses is largely due to extraordinary expenditures, the result of changes in subway equipment made necessary in connection with the operation of ten-car express and six-car local trains.

CUMBERLAND TELEPHONE & TELEGRAPH.

The report of the Cumberland Telephone & Telegraph for the month of November and eleven months ended November 30 compares as follows:

	1910	1909
November gross	$ 604,289	$ 560,032
Expenses	344,700	306,971
November net	259,588	253,061
Charges and taxes	56,518	40,742
November surplus	203,070	212,319
Eleven months' gross	6,295,372	5,852,986
Expenses	3,564,031	3,327,091
Eleven months' net	2,731,340	2,525,895
Charges and taxes	539,924	464,963
Eleven months' surplus	2,191,416	2,060,932

TWIN CITY RAPID TRANSIT.

The report of the Twin City Rapid Transit Company for the month of November and eleven months ended November 30 compares as follows:

	1910	1909
November gross	$ 619,149	$ 580,795
Expenses	319,732	273,044
November net	299,417	307,751
Chgs., tax & pfd. div.	137,912	140,251
November surplus	161,504	167,500
Eleven months' gross	6,884,875	6,354,177
Expenses	3,316,581	2,982,786
Eleven months' net	3,568,294	3,371,391
Chgs., tax & pfd. div.	1,539,886	1,529,012
Eleven months' surplus	2,028,408	1,842,379

AMONG THE CONTRACTORS AND SUPPLY MEN

EDGAR ZIMMERMAN of International Falls, Minn., has engaged in the electrical contracting business in that place.

DEWEY & COMPANY, of Plano, Ill., has been incorporated with a capital stock of $5,000 to deal in electrical goods, etc. Z.

WILLIAM M. KELLER, of Rock Hill, S. C., was awarded the contract to erect the power house for the municipal electric light plant.

THE AMERICAN ELECTRICAL COMPANY, Piqua, O., has been awarded the contract for electrical wiring on the new Church of the Brethren at Covington.

C. H. KELLER, dealer in electrical fixtures and general electrical contractor, has removed to larger quarters at 1081 Main Street, Dubuque, Iowa, because of increased business.

ALBIN GUSTAFSON COMPANY, New York, N. Y., has been awarded the contract for installing a motor fan in the ejector pit under the toilet rooms of the United States Post Office, New York.

THE ELECTRICAL CITY CONSTRUCTION COMPANY, Columbus, Ga., has succeeded the Hill Supply Company, and will conduct an electrical supply business in connection with its contracting work.

THE VALLEY ELECTRIC COMPANY, North Yakima, Wash., has wired nearly all the stores and offices in Granger, Wash., for electric lights. Power will be supplied by the Pacific Power & Light Company.

THE MOBILE ELECTRICAL SUPPLY COMPANY, Mobile, Ala., has completed the work of installing the electric lighting plant at Fort Morgan, which included the wiring of every building at the post and the installation of lights on the quartermaster's department wharf. The installation of the plant at Fort Morgan was one of the largest contracts ever handled in this section of the south. It included the lighting of the streets at the post with eighty-candlepower tungsten lights, installed on iron fixtures, the wiring of every building at the post and the installation of chandeliers and fixtures of the type adopted by the Government at all army posts. I.

New Electrical and Mechanical Apparatus and Appliances.

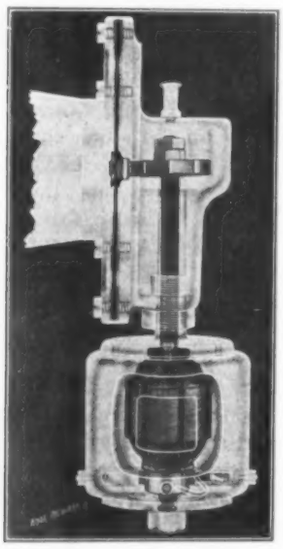
The Klaxon Warning Signal.

The Klaxon warning signal has, owing to its many commendable features, met with marked success as a warning signal for automobiles, motor boats, etc.

The sound waves in the Klaxon signal are caused by exceedingly violent and rapid vibrations of a tough chrome vanadium steel disk. The disk is vibrated by a hardened toothed wheel or rotor striking against a glass-hard button riveted in the center of the diaphragm. The rotor is keyed on the shaft of an electric motor. Current is supplied by eight dry cells or a six to eight-volt battery.

The diaphragm is five and one-half inches in diameter. The motor is a railway motor in miniature, with a laminated seven-coil armature and a commutator of standard type. The brush holders are arranged to take up automatically the wear of the brushes, and the latter are of copper gauze filled with non-fluid oil and self-lubricating.

The shaft is practically frictionless, with a ball-bearing base, and the ball-bearing is held in place by a steel cup and two ball retainers. The rotor and button have large surfaces.



PHANTOM VIEW OF KLAXON WARNING SIGNAL.

Owing to the absence of heavy rotating parts, the motor gains full speed almost instantly, hence the startling abruptness of the note.

In the accompanying illustration is shown a phantom view of the Klaxon, showing its mechanism.

These signals are being placed on the market by the Lovell-McConnell Manufacturing Company, Newark, N. J.

Speed Regulators for Alternating-Current Motors.

Due to many reasons, the use of the alternating-current motor has greatly

SPEED REGULATOR FOR ALTERNATING-CURRENT MOTORS.

increased during the past few years. The requirements have also changed as the real advantages of motor-drive such as well-controlled starting, speed regulation, etc., are desired. Individual motors are also used to a greater extent.

For some classes of work it is desirable to have speed control of induction motors. The speed can be regulated by an adjustable resistance in the primary or secondary circuit. Reducing the primary voltage by primary resistance reduces the torque so that with slip-ring induction motors the resistance is placed in the rotor or secondary circuit which permits larger torques at low speeds and is the better method.

In addition to other new alternating-current controlling devices the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has developed standard lines of speed regulators and controllers for slip-ring motors.

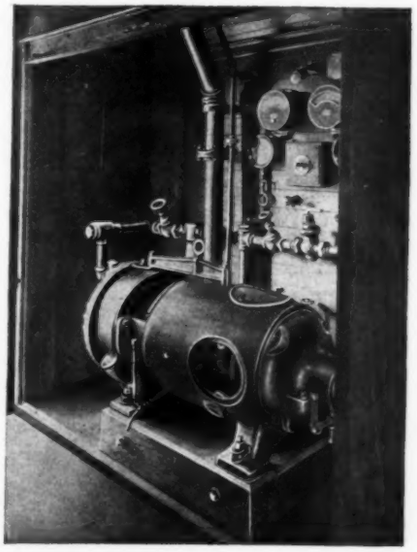
The face-plate regulator illustrated is made in several styles and types and in sizes of one-quarter horsepower to fifty horsepower. This apparatus is compact, inexpensive and practicable. The resistance is self-contained and is connected, when installed, in the secondary circuit. The segments are of hard drawn copper, readily replaced or interchanged without interference with the connections inside.

The three sets of resistances are delta connected so that equal amounts are inserted in the three phases of the secondary insuring a balanced condition. This is very important as the maximum output of the motor can be seriously effected by unbalanced currents or voltages in the legs of the motor. The standard apparatus is designed to reduce the speed fifty per cent at full load.

Another precaution is using German silver wire for the small regulators. This insures accurate speed control with no speed variation due to heat, the German silver wire having a zero temperature coefficient. Non-inductive grid resistance is used with the larger sizes.

Curtis Turbines for Train Lighting.

Curtis turbo-generators installed on a locomotive or in a baggage car meet the most exacting demands of train-



TURBO-GENERATOR INSTALLED IN BAGGAGE CAR.

lighting service. These sets, consisting of a Curtis turbine direct connected to an electric generator, form compact, sturdy units, so simple in construction

that they require practically no attention. At the present time, when the railroads are making every effort to insure the greatest degree of safety to their passengers, these sets are meeting with great favor, as their use absolutely eliminates all danger from fire or explosion due to the leakage of illuminating gas in case of an accident.

The superior quality of the light due to the excellent voltage regulation of the Curtis turbine is a feature which will be greatly appreciated by the passengers.

This service permits the use of cooking and heating utensils in buffet and dining cars, and of electric toilet articles in drawing and sleeping cars.

For suburban service no auxiliary equipment is required, and the Curtis turbine affords an exceedingly simple and very economical equipment, dispensing with batteries, boosters and regulators.

Over 300 Curtis turbines are now in use on steam railroads, and many roads have adopted this system as a standard equipment for train lighting. There are sixty-seven of these turbines now in service on the Chicago, Burlington & Quincy Railroad, forty-two on the Great Northern, forty-two on the Northern Pacific, forty-three on the Chicago, Milwaukee & St. Paul, and a smaller number on a large number of other roads.

Big Power Project.

New Zealand, it is stated, has in hand a huge scheme to supply electric power for all kinds of purposes from her great lakes and rivers, power for factories and railways and also for lighting purposes. It is proposed to establish several centers, and to spend $10,000,000 and four years in money and time to accomplish the work. Under the scheme the Dominion will be divided into seven districts, and each will possess a developing plant.

New Electric Tramway for Barbados.

United States Consul Chester W. Martin reports the sale of the Bridgetown Tramways Company to an American syndicate, which will convert this small nine-mile mule-power line into an extensive electric trolley system to various parts of the Island of Barbados. The old company was quite prosperous and paid large dividends.

Government Standard Portable Testing Set.

The Government standard testing set being placed on the market by the Thompson Levering Company, is in accordance to the Government specifications, and is arranged for the loop tests and resistance measurements. The set is in use by a great many telephone and telegraph companies as well as power-plants in general where tests are constantly being made.

The bridge arms have four cells of the values of 1, 10, 100 and 1,000 ohms, and are said to be accurate to one-twentieth of one per cent, and the rheostat consists of four sets of coils of the value of units, tens, hundreds and thousands, with ten coils of each value, giving a total of 11,110 ohms in one ohm steps, thus the theoretical range of the instrument, using ratios of 1,000 to 1 in the bridge, would be from .001 ohms to 11 megohms.

The galvanometer is of the D'Arsonval type, and has a very high sensibility. The magnet is made of the best grade of special magnet steel, carefully aged, and is permanent and strong. The galvanometer is very quick and positive in its action, and the construction and design is such that it is extremely dead-beat, making readings very easily and quickly. The galvanometer key is arranged with a short circuit device, which also helps to bring the needle to rest promptly. The galvanometer scale has thirty millimeter divisions with center zero, is well lighted and easily read, and the scale is uniform, making the set well adapted for making insulation measurements.

The batteries consist of six silver-chloride cells, and the set is so made that the batteries and galvanometer, with the coils, are attached to the rubber plate, so that in taking out the rubber plate the entire set is removed from the box.

A card of directions for the various tests, with formula, is provided with each set, so that one unaccustomed to making these measurements will have no difficulty in executing the same.

The Thompson Levering Company is the manufacturer of these sets.

Lighting a Pier with Flaming-Arc Lamps.

The amount of night work necessary to load and unload the cargo of steamships has made good artificial lighting necessary, and for single-story piers and those of two stories having ceilings of sufficient height, the flaming-arc lamp, on account of its economical operation, great brilliancy and penetrating power has proved a most satisfactory illuminant for lighting these large semi-open areas. An excellent example of pier illumination is afforded at the new pier of the Fabre Steamship Company at the foot of 31st Street, Brooklyn, N. Y.

VIEW OF PIER ILLUMINATED WITH FLAMING ARC LAMPS.

This pier is the largest in or about New York, being 1,476 feet long, 150 feet wide and 35 feet high. Being only one story in height, it is lighted during the day by means of skylights and whatever light comes in through the open doors. In fall and winter it becomes necessary to turn on the lamps as early as four o'clock.

The present lighting system, which

has been in operation about three months, consists of twenty-four Hawthorn flaming arc lamps, twenty-two of which are hung inside the building and the other two outside the building, one at either entrance. The lamps are hung in two parallel rows, there being eleven lamps in each row, hung about 120 feet apart, the distance between the rows being 50 feet.

Power is taken from a 2,200 volt, three-phase, sixty-cycle alternating-current transmission line, which is brought into the building near the front entrance and stepped down to 115 volts by a transformer. From the transformer a primary circuit of copper wire is run the length of the building. The entire lighting system is controlled by five control boxes, so wired that three of them control four lights each, and two of them six lights each, the lamps being connected two in series. This pier is so long that three vessels can be loaded at once, if necessary, and in that case all of the lamps would have to be burning. This seldom happens, however, a dozen lamps being a fair average load.

One of the obstacles met with in lighting this pier was the elevated platform shown in the photograph. It was thought at first that this platform, which extends the whole length of the pier, and is used for the convenience of passengers, would throw such a heavy shadow as to make the proposed plan of hanging the lamps impractical. It has been found, however, that while this platform is over eight feet wide, and but slightly below the level of the lamps, the row of lamps parallel to the platform, but about fifty feet from it, throws such a penerating light as to almost entirely overcome all shadows.

As in the case of foundries, machine shops and other large interiors, it is a great advantage to be able to hang the lamps as high as possible on a pier. Take the case of the Fabre line pier; this line operates a line of ships between Naples, Marseilles and New York, and its cargoes are principally olive oil, olives, wines, raisins, nuts and grapes. The last three are extremely bulky, and when unloaded are often piled almost ceiling high. One cargo recently unloaded contained 35,000 kegs of grapes alone, and this was but a part of one cargo being unloaded.

Rectifiers Charging Batteries of Fire-Alarm System.

The mercury-arc rectifier shown in Fig. 1 has been installed for charging the storage batteries which operate the

FIG. 1.—RECTIFIER SET IN FIRE-ALARM STATION.

fire-alarm system of the city of Sandusky, O. The battery (Fig. 2) consists of four sets of fifteen cells each, Chloride Accumulator, Type CT, and, with the present system, fifty fire-alarm boxes can be pulled at once.

Previous to the installation of the rectifier, a gravity battery, consisting of 108 cells, operated the fire-alarm system. The new installation effects a saving of $300 per year, as the expense of cell renewals when gravity batteries were used was a large item of expense. The first cost of the new equipment, including rectifier, battery and distributing board installed complete, was $589, while the cost of power for its operation is about $1.40 per month at a ten-cent per kilowatt-hour rate.

This equipment is operating very satisfactorily and during the six months that it has been in operation absolutely no trouble of any kind has been experienced with it.

The rectifier panel was furnished by the General Electric Company, Schenectady, N. Y.

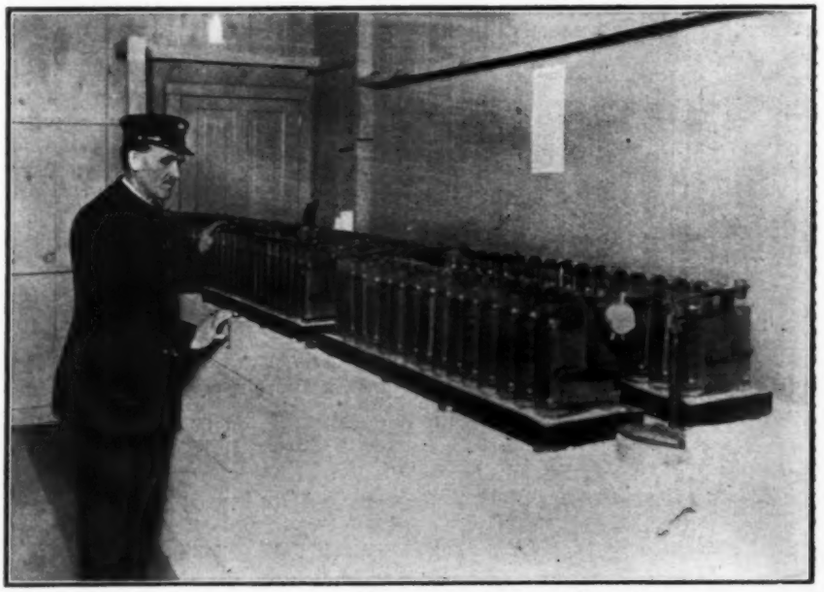


FIG. 2.—VIEW OF STORAGE BATTERY INSTALLATION.

New Form of Printing Attachment.

The Minerallac Electric Company, 1004 West Van Buren street, Chicago, has developed a new form of portable Chicago printing attachment. This new device has been developed to meet the demands for a self-contained instrument for testing purposes to determine load factor for different periods, demand at different hours of the day and any other information of this kind. The complete outfit consists of one of the Company's standard type C printing attachments, one contact-making clock and one battery of dry cells, all protected by a well-finished, oak carrying case. With this form of attachment a test on a customer's line is very simple, all that is required being the connecting of the three binding posts on the top of the attachment to the wattmeter register. The Company's new bulletin No. 25 describes this attachment as well as other features.

Compensated Gas-Filled Recording Thermometers.

During the last fifteen years Bristol recording thermometers have been constructed in various different forms, depending for their operation on the expansion of a liquid, the expansion of the vapor of a liquid or the expansion of a gas. These thermometers have been used very extensively for ranges of temperature up to 800 degrees Fahrenheit, and the model equipped with flexible connecting tube between the sensitive bulb and recording instrument and depending for their operation on the expansion of a vapor or a gas have not until recently been adapted for recording the lower ranges of temperature.

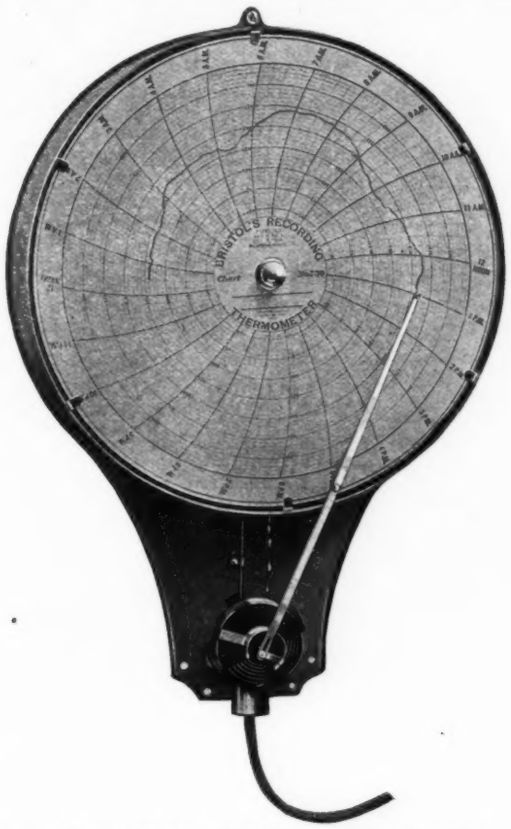


FIG. 1.—GAS-FILLED RECORDING THERMOMETER.

A new compensated gas-filled Bristol recording thermometer has recently been developed for recording the lower ranges of temperature, such as atmospheric temperatures, temperatures of water, temperatures of brine in refrigeration systems, etc., and found satisfactory in numerous tests. These thermometers are equipped with a patented compensating device, which automatically corrects for changes of temperature at the recording instrument.

Bristol's gas-filled class III recording thermometers are equipped with sensitive bulb and flexible capillary connecting tube and a patented pressure tube, as shown in Fig. 1, the sensitive bulb and flexible connecting tube, and spiral pressure tube all being filled with an inert gas under pressure. Changes of temperature at the sensitive bulb cause corresponding changes in the pressure of the confined gas, and these changes in the pressure are measured and recorded by the recording instrument, the interior construction of which is shown in Fig. 1. The sensitive bulb is usually about ten inches long and three-quarter inch in diameter, and the volume of gas contained in this sensitive bulb is very large in proportion to the volume of gas contained in the fine capillary connecting tube between the sensitive bulb and the recording instrument, this making the error due to changes of temperature along the connecting tube negligible.

The important new feature of Bristol compensated gas-filled recording therometer is the patented compensating attachment for the spiral pressure tube, since a thermometer equipped

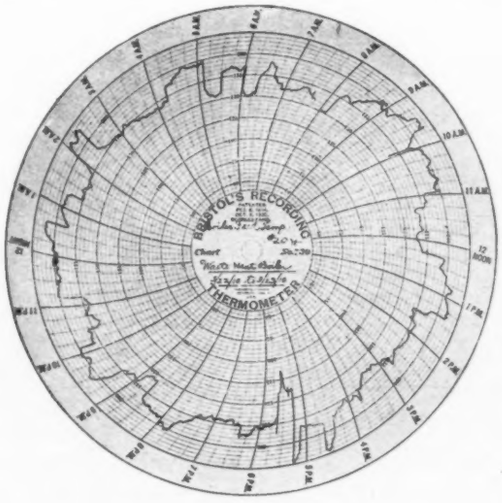


FIG. 2.

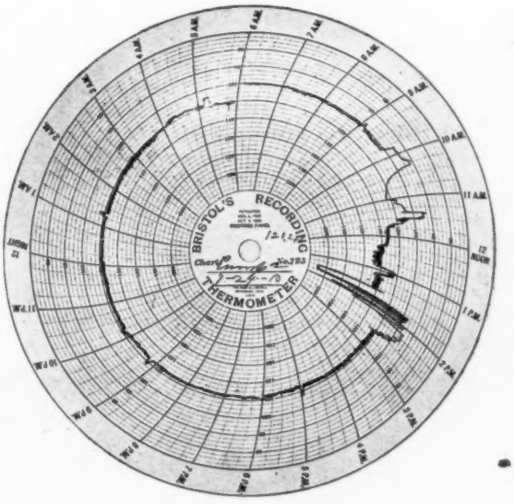


FIG. 3.

with this compensator gives the same readings or record when the temperature at the recording instrument changes, as it would if the temperature at the recording instrument remained constant.

Fig. 2 shows a record of feed-water temperature recorded by one of these instruments, the chart having range of 40 to 225 degrees Fahrenheit. It will be noted that the scale of this chart has uniform graduations over the entire range, and this makes it possible to use the Bristol-Durand radii averaging instrument for computing the average of the feed-water temperatures for the twenty-four hours.

Fig. 3 shows a record of condenser water temperatures, as recorded by one of these thermometers on a chart having range of 40 to 220 degrees Fahrenheit. It will be noted that this chart has a reversed scale of uniform graduations. For condenser water temperature the reversed scale is a desirable feature, as the average temperatures are usually lower than 125 degrees, whereas the temperatures are likely to reach boiling point occasionally, at times of loss of vacuum in the condenser.

Life of Electrical Apparatus.

Electrical apparatus is generally considered to be less rugged than some other classes of machinery, but the accompanying illustrations and explanation show through what severe ordeals it may sometimes pass without serious damage.

The illustrations show two Bullock motors taken from the ruins of the Los Angeles Times building. After the explosion of gas and resulting fire which recently destroyed this building, these motors were removed from the basement where they were lying in five feet of water. The presses to which they were attached were completely destroyed and had no value except as scrap iron. The motors, however, were not badly damaged and were practically the only articles of value saved from the ruins. In the adjustment of losses made by the Fire Underwriters' Association, ninety-nine per cent of the total insurance was allowed, the one per cent saving being based almost entirely on the value of the motors. The insulation of these was destroyed, but the commutators, brush holders, bearings and frames of the machines were in perfect condition.

RECEIVER AFTER TEST.

TRANSMITTER AFTER TEST.

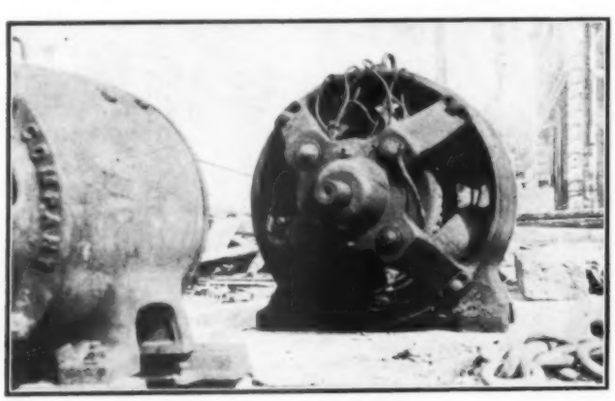
The motors attracted considerable attention and excited much comment because of the fact that they were the only pieces of machinery saved from the ruins. The larger motor is a sixty-horsepower, 500-volt, 400-revolution-per-minute machine, while the smaller is a ten-horsepower, 450-revolution-per-minute machine. They are now being re-wound in the shops of the manufacturer, Allis-Chalmers Company, and will be used to drive new presses in the new building which is soon to be erected.

New Telephone Receiver.

The Kellogg Switchboard & Supply Company has put on the market a reinforced receiver, which has proven as successful and popular as their steel, rubber-insulated mouthpiece.

This improvement was perfected after careful study and experiment. Like the mouthpiece, also described in these columns, the receiver is composed of a metal ribbed frame, around which the rubber insulation is forced by special machinery under great pressure. This process insures freedom from cracking and chipping. The cap of the receiver is reinforced by a metal perforated disk, flanged at the outer edge. This disk is perforated, allowing the insulation to secure a firm hold and the flange at the edge of the disk protecting the threaded portion of the receiver cap.

The illustrations shown herewith are photographs of a severe test to which one of these receivers and mouthpieces were recently subjected. The illustration is from an actual photograph of an unbreakable receiver and reinforced mouthpiece, which were thrown against a cast-iron steam radiator by J. J. Jennings, superintendent of telegraph, Chicago, Rock Island & Pacific Railway.



BULLOCK MOTOR AFTER FIRE.

SIXTY-HORSEPOWER MOTOR TAKEN FROM RUINS.

The sales of the Western Electric Company for 1910 are estimated at $66,000,000.

Current Electrical News

GREAT BRITAIN.

(Special Correspondence.)

LONDON, DECEMBER 31.—Fuller particulars are now available of the numerous proposals that will come before Parliament next session, seeking powers to run trolley omnibuses in various parts of the country. Some half dozen corporations are now desirous of adopting the mode of traction as an addition to their existing tramway systems, and about the same number of new companies are to be formed with similar objects in view. With the exception of two, all the companies are being promoted by the same group of men, the capital in each case being $300,000. In more than one instance there will be competition for the right to run this class of vehicle, either between a company and the corporation, or between two companies.

With the near approach of the transfer of the telephone business of the country to the Government, an agitation is being started for a revision of the present system of tariffs, while the question of local authority control is again being raised. As to the latter, it would seem to be waste of time to argue the point, as the Government policy in this respect was settled several years ago. The local authorities had their opportunity and allowed it to pass. Even so communistic body as the Glasgow Corporation, which was the leader in the agitation for municipal telephones, found it to its advantage to part with that undertaking some years before the expiring of its license, and only the corporations of Hull and Portsmouth survive to remind us that municipal telephony ever came within the bounds of practical realization. There is considerably more hope that there will be a revision of tariffs, for Mr. Buxton, the late Postmaster General frankly stated on more than one occasion that the charges for the new message rate system were fixed with a view to ascertaining the margin of profit which they left, and that the results obtained prior to the acquisition of the Company's business, would be used as a basis to guide the department in framing a tariff when the whole of the country's telephone system is under State control.

The hopes of the British Electric Traction Company that its new system of fares, with half-cent stages, would serve to raise the average receipts from its numerous undertakings—which have shown an alarming diminution during the recent years—have by no means been realized. Week by week one local manager after another finds the system of half-cent stages unworkable mainly owing to the increase in the longer distance fares, which is involved. The trafic returns have not manifested the expected tendency to increase.

In the midst of the controversy between the municipalities and the electric wiring contractors as to the former wiring houses and letting apparatus on hire, etc., it is instructive to note that an important London borough Council, viz., Islington, has come to the conclusion that a vast amount of business is being missed because the municipal electricity department has not taken up the wiring of premises and the hiring of apparatus. All London boroughs have the powers to do this, but wth few exceptions. it has been left to the contractors to develop this side of the business. In Islington, as elsewhere, the contractors are hardly working on the lines which bring the best results to the supply authority, and the latter has decided to establish a business getting department.

Much has been made from time to time of the advantage which the public in Westminster has received by changing from electricity to gas for street lighting. Last week, however, it was publicly stated at a Westminster City Council meeting that the shopkeepers in Regent Street—one of London's most important and fashionable thoroughfares—considers the gas lighting to be very inefficient, compared with electric. G.

CONTINENTAL EUROPE.

(Special Correspondence.)

PARIS, DECEMBER 28, 1910.—The new high-power wireless station at the Eiffel Tower is now entirely installed, and tests will begin with the apparatus very shortly. President Fallières and an official delegation lately made a visit to the new plant, and were received by General Brun, Minister of War and Lieut.-Col. Ferrié, the well known military wireless engineer, who is in charge of the station. It will be remembered that the post is entirely underground and has aerial wires running to it from the top of the tower.

Among recent traction enterprises in France, I note the projected electric tramway line running between St. Seine and Aignay. A suburban tramway will be built from Dijon to the locality of Beaune. Another projected line will run from Maule to Meulan. In the Algerian colonies, the Government has decided to run telephone lines between Kroubs and Ain-Abid and also from Tizi-Ouzou to Mirabeau.

The railroad department of Austrian Poland has organized a syndicate for the electric lighting of the town of Rseszou. At Jicin, Bohemia, there will be erected a central station using two steam-engine groups. The Vienna Siemens-Schuckert firm is engaged upon a project for installing a station and a power network in Bohemia for lights and power, and also for agricultural use.

A trackless trolley line will be installed shortly between Hull and Schwaz, in the Tyrol region. The outfit will be supplied by a German electrical firm. At Graz there is to be installed a central station for a large block of office buildings in the city. Among other Austrian projects I note a hydraulic plant which will be erected for the convenience of Schottwien. A new electric traction line is planned for Vienna. An extensive traction project is the one which the government railroad administration is planning in the Tatry mountain region. It will start from the locality of Tatranska.

The Siemens-Schuckert firm is engaged upon the plans for a central station to be located at Burghammer. Lignite is to be used for the furnaces, seeing that there are extensive lignite beds in this region. At first there will be erected three alternator groups in the station.

The Northern Railroad Company of Spain is to build a double-track electric railroad from Burgos to the town of Miranda. It will be one of the most important of the kind in this country, as it has about sixty miles length. I also note an electric railroad which is in construction between St. Sebastian and the locality of Beasin.

In Italy, a local company has obtained the rights from the Mediterranean Railroads for the construction of a seventy-mile electric railroad between Umbertide and Terni. A. DE C.

EASTERN CANADA.

(Special Correspondence.)

OTTAWA, ONT., JANUARY 7.—The Shawinigan Power Company is applying to the Quebec legislature for the right to increase its capital stock, if necessary, to an amount not exceeding $20,000,000.

Telephone connection with Kelso, and virtually with all points of the new gold district of Porcupine, Ont., is now possible to Toronta and any other points on the Bell Telephone system.

Following the order of the Dominion Railway Board, a flat rate of $30 for house and $50 for business telephones, is now in force in Toronto. The former rate discriminated against portions of the city recently annexed.

Petitions are being circulated, in the localities interested, asking the Dominion government to consider the feasibility of a canal across western Ontario from Goderich to Hamilton. It is pointed out that this would give an all-Canadian canal route to the upper lakes, while the fall of 200 feet would furnish immense water power for the generation of electric energy.

Water powers adjacent to Calabogie, Renfrew County, Ont., and High Falls, in the county of Labelle, Que., have been secured by a number of capitalists, and will be utilized to generate and transmit electric power through a portion of eastern Ontario. It is stated that such energy can be supplied municipalities for not more than $20 per horsepower per annum.

Local capitalists in the city of Brantford, Ont., are applying to the Dominion Parliament for a charter for the Lake Erie & Northern Railway, which is projected to run from Port Dover to Simcoe, Waterford, Brantford, Paris and Galt, in the province of Ontario. Authority is also sought to operate electric, telephone, telegraph and power lines, and to generate and sell electric power.

Arrangements have been completed for the early construction of an electric belt line to cover the rural districts between Ottawa and Brockville. The road will be financed by English capitalists. The company's charter gives it the right to sell light and power, so that municipalities along its course will be supplied to the full in all lines for which electrical energy is used.

A huge merger of power companies in that portion of Ontario, between the cities of Kingston and Oshawa, has been formed, the combination taking the form of a holding company, to be known as the Electric Power Company, Limited. It is said that the capital of this big concern will be $100,000,000. It holds a Dominion charter, and has bought up, or is buying up, control of all the power companies in the Trent Valley district. The Electric Power Company, is apparently organized to thwart the extension of the Ontario Government's hydroelectrical movement east of the city of Toronto. The following named concerns

are now merged in the holding company: The Seymour Power & Electric Company; The Peterboro Light & Power Company; The Peterboro Radial Railway Company; The Auburn Power Company of Peterboro; The Trenton Electrical & Water Company; The Sydney Electrical Power Company; the Nipissing Power Company of Oshawa Electric Light Company; The City Gas Company of Oshawa; The Coburg Utilities Corporation; The Northumberland-Durham Power Company; The Central Ontario Power Company. The Electric Power Company derives its energy chiefly from the Seymour Power & Electric Company, at Campbellford, and proposes to develop as speedily as possible, a number of powers along the route of the Trent Valley canal, from Burleigh Falls to Trenton. The present development, from five points, amounts to 10,000 horsepower, and two other power houses, having a combined capacity of 75,000 horsepower, are now under construction. The maximum development is said to be 100,000 horsepower.

WESTERN CANADA.

(Special Correspondence.)

WINNIPEG, MANITOBA, JANUARY 5.—After being on strike for sixteen days the conductors and motormen of the Winnipeg Electric Street Railway Company decided to return to work, accepting the Company's offer. This decision was reached during the afternoon of December 31 and on January 2 a number of the old men were back on their cars. However, the offer of the Company was only to take back 300 of the strikers, the Company to give the married men the preference and reserving the right to retain some 400 of the strike breakers. The strike was called on December 16, because the Company persisted in discharging three men who were found drinking in a saloon while wearing the Company's uniform.

The announcement is made that power from Winnipeg's civic plant at Lac du Bonnet, which is now being completed at a cost of approximately $3,500,000, will be turned on July 1 next and that day will be declared a public holiday. This is the biggest civic power plant in Canada.

The annual report of the civic telephone department of Edmonton, Alberta, shows that on November 1, there were 2,368 telephones in use in that city compared with 1,800 a year ago. The report anticipates an increase of another 1,000 telephones before the end of the present year. During the past twelve months the City has strung 4.66 miles of aerial cable and 2.33 miles of underground.

The City of Fort William, Ont., is about to raise $75,000 for extensions and improvements to the municipal street railway system. Work will be commenced as early in the spring as weather will permit.

Charles E. Taylor, manager of the Tofield Coal Company, has applied for a franchise for an electric light and power plant at Tofield, Alberta, and says he is backed by sufficient capital to install a plant large enough for all needs of the town.

The increase of telephones in Winnipeg, Man., during the past year is 3,437, there being now 16,161 telephones in that city. So rapid has been the increase that the three exchanges were worked to capacity and on January 9 a fourth exchange was opened and arrangements are now being made to open a fifth. The rates are $24 for residential phones and $50 for business houses.

The City of Regina, Sask., has placed an order with the Ottawa Car Company, Ont., for four double-truck street cars and two single-truck for the municipal street railway system now under construction. It is expected the system will be in operation by July of this year.

Rumors are in circulation in Vancouver, B. C., to the effect the Canadian Pacific Railroad is about to build an electric street railway to Portland, Ore., and Seattle, Wash. Along the proposed route there is some 500,000 horsepower available from various streams. However, whether the Canadian Pacific is the Company behind the deal or not is not known but some company intends to build the line, for engineers are now making surveys and taking notes of the electrical powers available.

The British Columbia Hydraulic Power Company is applying for 300 cubic feet of water per second from Nanaimo Falls, on Vancouver Island, for the purpose of generating power. The head office of the company is at 415 Winch Building, Vancouver, B. C.

A syndicate of capitalists from Vancouver, B. C., has applied for a franchise for a street railway system at Brandon, Man. The negotiations are, as yet, in a preliminary stage.

There is agitation, and promises from official circles, for a telephone line between Nelson and Waneta, in British Columbia, with branches to a number of outlying towns in the vicinity of the two places. Address G. S. Coleman, Ymir, B. C., for further particulars.

At Porcupine, in New Ontario, A. E. Wallberg is now installing an electrical power plant which will supply light and power to the surrounding district as well as to the proposed electric line to be built by the government this spring.

Messrs. Smith, Kerry and Chase, consulting engineers, Toronto and Winnipeg, have been retained by the Town of Pincher Creek, Alta., to value the plant of the Pincher Creek Brick, Power & Light Company, with a view to the town taking over all the holdings of the Company pertaining to electric light and power.

COMMISSION NEWS FROM NEW JERSEY.

(Special Correspondence.)

The State Board of Public Utility Commissioners, in its report to the Governor, mentioned the value of co-operation with the public service companies and stated that through observance of this principle the recommendations of the Board were generally adopted by the companies interested. The matter of protection of grade crossings was taken up and recommendations were made as to the division of expense of such protection between the railway company and the state.

In a number of cases, investigations of accidents disclosed conditions calling for improvement and many recommendations, made by the Board, based upon examination of these conditions, have been adopted by the railroad companies. These recommendations have included the installation of an interlocking system (where a collision occurred at a crossing of the tracks of two companies), the improvement, in a number of cases, of yard switches, installation of derails and improvements in signaling systems. Additional protection has been provided at a number of crossings of highways, as mentioned above.

The system of inspection of the physical properties of the railroads has been continued, and plans were also recommended for the protection of draw bridges.

The organization of the Board has been maintained, the body being divided into two parts, the Railroad Division and the Utilities Division. Of the first of these Charles D. McKelvey is at the head, as chief inspector, while Philander Betts holds the corresponding office with the latter division.

Courtesy has been extended by Rutgers College at New Brunswick, for the testing work of electric meters, and proper apparatus will be installed there.

The Board is given power to require every public utility to keep its books, record and accounts so as to afford an intelligent understanding of the conduct of its business and to that end to require every such public utility of the same class to adopt a uniform system of accounting.

With the aim of having established uniform systems of accounting, conferences have been called with representatives of street railway, gas, electric light, telephone and water companies. Numerous suggestions have been made to the Board and this matter is now under consideration. The limited amount of the Board's appropriation has restricted it in the employment of accountants whose advice would be of material assistance, and the problem of uniform accounting has not been solved as expeditiously as is desirable. It is hoped that the progress the Board is making with the means at its command will enable it to settle this matter at an early date.

The statute of 1910 extends the jurisdiction of the Board to express, street railway, traction, canal, subway, pipe line, gas, electric light, heat and power, water, sewer, telephone, telegraph or other corporation, association or joint stock company, operating within the State of New Jersey for public use, under privileges granted by the State, or by any municipality thereof.

Section 8 of the act of 1907 provides that upon the failure of any company to comply with any order of the Board, such failure should be reported to the Attorney-General, whose duty it should be "to institute proper proceedings to enforce the order or orders of the Board, to recover suitable penalties or damages, or to institute proceedings in equity, mandamus, injunction, receivership proceedings or other civil remedies."

Recommendations were made to give the Board the right to adopt and fix by general orders, standards of service supplied by electric lighting, street railway, water, telephone and other public utility corporations subject to the jurisdiction of the Board.

COMMISSION NEWS FROM WISCONSIN.

(Special Correspondence.)

The special legislative committee appointed at the last session of the Wisconsin Legislature to consider and report on the waterpower question will recommend the passage of a bill by the next legislature which will place the control of the waterpowers of the state with the Railroad Commission. Some of the provisions of the new bill are: (1) Future franchises issued for the development of waterpowers are placed under the control of the Commission. (2) Waterpowers now operating under legislative authority are given three years to accept the provisions of the act and failure to do so forfeits the franchise. (3) The franchises under the control of the Commission are to be made indeterminate. (4) The control of the Commission in the case of new powers extends to the location of the dam from which the power is to be obtained. (5) In case of existing waterpowers where the power is not now fully developed it is placed with the Commission to say whether new waterpower sites on the stream can be utilized, and if so, where the dam shall be located. (6) When waterpower franchises come under its control, power is to be given the Commission to issue orders regulating the flowage, controlling the use of the power, and to decide practically all questions in regard to its operation. In cases of leases of the power the control of the contract rates for its use is to be left with the Commission.

The Commission has authorized the Chippewa Valley Railway,

Light & Power Company to issue stocks and bonds as follows: (1) 3,000 shares of common stock of the par value of $100. (2) $250,000 par value of first-mortgage twenty-year gold bonds of the domination of $1,000 each, bearing interest at the rate of five per cent per annum, said bonds to be issued in accordance with the terms of a deed of trust issued to the Harris Trust and Savings Bank and Andrew Cooke, of the city of Chicago, trustees. (3) The stock is to be issued for cash at the par value for the purpose of acquiring the property of the Chippewa Falls Water Works and Lighting Company; to pay its floating indebtedness incurred in main extensions and additions and for making further additions and extensions; or said stock may be issued in exchange at par for the property of said company, the value of which property has been determined by the Commission. (4) Said bonds shall be issued and sold for money at not less than seventy-five per cent of the par value thereof, for the purpose of supplying the company with funds for making extensions and additions to its property and purchasing additional equipment.

John C. Burns, a dealer in fruits and other merchandise in the city of LaCrosse petitioned the Commission to issue an order compelling the LaCrosse Gas and Electric Company and the LaCrosse Telephone Company to remove poles which prevented the expansion of the tracks of the Chicago, Milwaukee & St. Paul Railway Company along an alley way to the petitioner's warehouse. The Commission after considering the facts and the laws and ordinances under which the several companies concerned are operating stated: "The Telephone Company obtained its right to occupy the streets and alleys of the city direct from the state. The Gas and Electric Company obtained such right from the municipality. Of course, privileges of this character merely confer rights as against the public. Abutting property owners must be compensated for the additional burden upon the fee caused by the location of the telephone and electric poles within streets and alleys. In the present case property owners are not complaining, and, if they have not been compensated for the location of the poles in question, their rights in the premises have been barred by the statute of limitations. Obviously, under the circumstances, the respondents cannot be compelled to incur the expense of moving the poles in question to enable the railway company to extend its spur track to petitioner's industry."

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

At the conference regarding accidents on interurban railways, which is to be held at Syracuse on January 19 at the request of the Public Service Commission the following papers will be read: "Methods of Employment, Instruction and Discipline of Motormen and Conductors on Interurban Roads," J. K. Choate, general manager Otsego & Herkimer Railroad; "Collisions on Interurban Roads and Their Causes," E. F. Peck, general manager Schenectady Railway; "Train Dispatching on Interurban Roads," C. E. Lewis, chief train dispatcher New York State Railways; "Block Signals on Interurban Roads," W. K. Howe, signal engineer.

The fourth annual report of the Public Service Commission, First District, which has been presented to the Legislature, states that during the year 2,711 matters were considered, which does not include those relating to rapid transit. Of these 194 were formal cases and 2,517 informal cases. Of the formal cases, 53 remained undetermined at the end of the year. In the formal cases there were during the year 527 hearings, generally held before one Commissioner, provided by law. The report states that 1,037 companies under the jurisdiction of the Commission have been organized, of which seventy-five companies are now operating. The following table shows the amount of securities approved and disapproved by the Commission:

Total amount securities applied for	$361,138,940
Amount approved by Commission	82,458,400
Amount disapproved by Commission	208,829,300
Amount withdrawn by petitioners	390,000
Amount pending December 31, 1910	69,461,240

The most involved case as to the issuance of securities, the report states, has been the application of the Bondholders' Committee of the Third Avenue Railroad Company, the details of which appeared some time previously. The amount of securities pending includes 64,851,500, applied for by the Metropolitan Bondholders' Committee, $109,740 applied for by the Coney Island and Brooklyn Railroad Company, $2,500,000 applied for by the Kings County Electric Light & Power Company and $2,000,000 applied for by the New York & Queens Electric Light & Power Company. The last mentioned application was made July 30, 1907. The following figures show the growth of street railway travel in New York City since 1901:

Year.	Population.	Fare passengers.	Rides per capita.
1901	3,549,843	881,344,801	248.2
1902	3,662,483	938,898,964	256.3
1903	3,775,123	1,000,767,483	265.0
1904	3,887,763	1,065,984,910	274.1
1905	4,000,403	1,130,982,696	282.7
1906	4,153,699	1,251,841,175	301.3
1907	4,306,995	1,315,381,388	305.4
1908	4,460,291	1,358,000,407	304.4
1909	4,613,587	1,402,417,642	303.9
1910	4,766,883	1,530,000,000	320.9

LIGHTING AND POWER.

(Special Correspondence.)

WETUMKA, OKLA.—An electric light plant has been installed here and is now in operation.

AUBURN, PA.—The Auburn Electric Light, Heat & Power Company has been incorporated with a capital of $15,000.

WEATHERFORD, TEX.—The Crystal Ice Company of this place will, in a short time, install and operate an electric light and power plant. D.

PITTSBURG, PA.—A building permit has been issued to the Duquesne Light Company for a one-story steel and brick power house.

WILLOW, CAL.—C. R. Wickes has been granted a franchise for an electric plant for all commercial purposes, to be erected in this city.

VICTORIA, TEX.—The city's new lighting system, including seven arc lights and 150 tungsten lamps, was recently put in operation.

ST. LOUIS, MO.—Bills introduced in the council to secure a new $71,000 sewer in Forest Park included an electrically operated pumping station to cost $5,000. Z.

BERKELEY, CAL.—A provision has been made by the City Council for installing electric lights on Center Street from Oxford Street to Shattuck Avenue.

FALFURRIAS, TEX.—G. W. Smith of Cleveland, O., has purchased the electric light and power plant here and will make improvements and extensions. D.

SENECA FALLS, N. Y.—The Geneva-Seneca Electric Company has installed a system of ornamental electric lamps along Fall Street in the business section.

CLIFTON SPRINGS, N. Y.—New machinery has been installed in the plant of the lighting company in this place, under the direction of G. A. Durkee, superintendent.

SAYBROOK, ILL.—R. Cooper, owner of the electric lighting plant which was recently burned here is figuring on a new plant to supply Saybrook, Arrowsmith and Gibson City. Z.

SYLVIAN, OKLA.—The city is installing a new electric-light plant to replace the one which was destroyed by fire several months ago. At Pretty Prairie a plant has also been installed.

INDEPENDENCE, KANS.—Plans have been advanced for installing an ornamental lighting system on the streets of this city. Sample poles and lights have been placed on exhibition.

KAUKAUNA, WIS.—Voters decided at a special election that the city should own its own lighting plant. The Kaukauna Gas, Power & Electric Company recently forfeited its franchise. Z.

JACKSON, CAL.—John L. Henry has been granted a fifty-year franchise for the purpose of constructing and operating a power line. He plans to furnish lights for the town of Plymouth.

WORCESTER, MASS.—About 300 tungsten lamps were put in service here a short time ago, some replacing gasoline light and some being placed in parts of the street not heretofore luminated.

COLLINSVILLE, ILL.—The Collinsville Electric Light Company has let the contract for its new power house, and work will begin soon. When the plant is complete a number of new lights will be added.

WACO, TEX.—The proposition of erecting a municipal electric light and power plant here will soon be definitely acted upon by the city authorities. It is planned to issue $250,000 of bonds for the purpose. D.

BARRY, ILL.—A. R. Weeks has asked the City Council to negotiate with him for a contract to light the City. It is understood he purposes purchasing the plant of Mr. Hillman, now in operation here. Z.

GEORGETOWN, CONN.—The work of installing the electric lighting service in the streets of this city is nearly completed. Power will be supplied by the Connecticut Company, and incandescent lamps are to be used.

CROWLEY, LA.—It has been decided to install in the municipal lighting plant here a new 110-horsepower engine, a 150-kilowatt dynamo and a seventy-five-kilowatt dynamo. A twenty-four-hour service will be inaugurated.

ST. LOUIS, MO.—The Ozark Power and Water Company has been incorporated with $5,000 capital to generate and distribute electric power. The incorporators are R. W. Morrison, Chester E. Burg and Frank Nottbusch. Z.

RED BLUFF, CAL.—A. G. Simpson of Chico, Cal., has appropriated 8,000 miners' inches of the water of Deer Creek, for the generation of electric power. A power station is to be erected about fifteen miles east of Vina. A.

STREATOR, ILL.—The Commissioners of Otter Creek Township have granted a franchise to the Illinois Valley Gas & Electric Company to build lines through the township. This provides for utilities to Ransom and Mazon. Z.

BANCROFT, MICH.—The Shiawassee Light & Power Company and the Owosso & Corunna Electric Company have consolidated

and the resultant company is to be known as the Consumers' Power Company. James D. Young has been chosen manager.

WEIMER, TEX.—The Weimer Water, Light, Ice & Cold Storage Company, which was recently organized, has taken over the electric light plant here and will enlarge and improve it by installing additional machinery. William Hillje is president. D.

CLARKSTON, WASH.—The Lewiston-Clarkston Improvement Company is planning a hydraulic power plant on the Grande Ronde River for the development of not less than 10,000 horsepower. Wynn Meredith has been engaged as a consulting engineer.

OKLAHOMA CITY, OKLA.—The Western Power and Irrigation Company of Oklahoma City has been incorporated with a capital of $500,000. Directors are George W. Frye and O. T. Berryman of Oklahoma City and W. Bolton Key of Maysville, Ky.

DURANT, OKLA.—The City Council has ordered plans drawn for an electric plant capable of supplying 100 arc lamps and sufficient additional current for commercial lighting. The City will pay for the plant out of $20,000 derived from the sale of bonds.

STREATOR, ILL.—C. A. Munroe, of the Illinois Valley Gas & Electric Company, of Joliet, is urging the boulevard lighting system for Streator, and an engineer for the company will prepare plans for an illumination scheme for the business section of the city. Z.

HOOD RIVER, ORE.—The Hood River Electric Light, Water & Power Company has been sold to the Washington and Oregon Electric Corporation, for $70,000. The purchasing company is to assume the bonded indebtedness, amounting to about as much more. A.

BRYANT, S. D.—The business men here have subscribed a fund of $3,000 which has been loaned to the town, and which will be used to install an electric light system here. The plant will be installed as soon as possible, preliminary work already having commenced.

WHITEWOOD, S. D.—The Whitewood Electric Light & Power Company has been granted a charter to sell electricity and work has begun upon a pole line between this place and Deadwood, where current will be secured from the plant of the Consolidated Power & Light Company. Z.

MONTGOMERY, ALA.—Plans for improvements involving the expenditure of $350,000 are being drawn up for the Montgomery Light & Power Company. It is expected that the capacity of the plant will be doubled. As soon as plans have been completed work on the plant will begin.

MINNEAPOLIS, MINN.—Proposed articles of incorporation of the Twin City High Dam Commission show that the power secured under the new project shall be available only to the cities of Minneapolis and St. Paul for lighting purposes and to the State University for lighting and power. Z.

CHICO, CAL.—A. F. Smith, president of the Sacramento Valley Power Company, announces the sale of a half interest in that corporation to Fleishhacker Brothers. The Company will be reincorporated with a capital stock of $2,000,000, and bonds for an equal amount will be issued. A.

ROSEVILLE, CAL.—The Pacific Gas and Electric Company is expending approximately $8,000 in extensive improvements in Roseville. The street-lighting system is being rebuilt and improved, and the lines are being extended into Cherry Glenn, giving service to territory hitherto untouched.

MINNEAPOLIS, MINN.—Mayor James C. Haynes, in his annual message to the City Council, recommended that all the old-style open-arc lights be replaced by new magnetite lamps or a lamp equally as good and provision for recording instruments to show the current furnished the lamps. Z.

PHELPS, N. Y.—The Board of Village Trustees recently received bids on propositions to light the streets of the village of Phelps under a five-year contract. Propositions one and two call for an all-night and 12 o'clock service respectively with forty-three arc lamps of 1,600 candle power each.

BROCKPORT, N. Y.—The Sweet Electric Light and Power Company, which supplies this village, has just completed the transformer station to replace the original steam plant which has been in service here for many years. Power is transmitted from the hydroelectric plants at Medina and Waterport.

ABERDEEN, WASH.—The Citizens Lighting & Power Company which has recently applied for a franchise, plans to furnish light and power for the city and also to operate an electric railway. The Company has leased the Anderson & Middleton Mill's power plant which is capable of generating about 1,700 horsepower.

SOUTH BEND, WASH.—Charles Jacobs of Portland and P. H. Ridgway of Raymond have sold the majority stock of the South Bend-Raymond Electric Company to F. S. Fisher of Ballard and R. L. Fisher of Raymond, the consideration being $85,000. Many improvements will be made and the efficiency of the plant considerably increased.

LANSING, MICH.—The Au Sable Electric Company has applied to the Railroad Commission for permission to issue bonds to the extent of $450,000 for the purpose of completing the hydroelectric installation on the Au Sable River. Present plans include the extension of lines to Saginaw, Flint, Owosso and a number of other cities in lower Michigan.

ST. LOUIS, MO.—Officials of the Union Electric Light & Power Company have been requested to submit before January 17 any arguments opposing a reduction of rates which probably will be recommended on that date by the Public Service Commission. The Commission, it is said, has decided that profits will be allowed upon but about one-half of the outstanding $25,500,000 in stocks and bonds. Z.

DECATUR, ILL.—An agreement has been made between the Wabash Railroad and the Decatur Railway & Light Company whereby all the electrical power for the railroad properties here will be supplied by the local McKinley plant. This contract will call for about 1,400 horsepower continuously. Within ninety days the engines and generators in use at the Wabash repair shops here will be sent to the road's plant at Moberly, Mo. Z.

LOS ANGELES, CAL.—The new electric power plant of the Pacific Light & Power Company at Redondo Beach has been completed at a cost of $1,000,000. The new plant is capable of generating 65,000 horsepower, and is an expansion of the original power house at Redondo Beach, built three years ago and having a capacity of 25,000 horsepower. The power of the new plant will be distributed between the Pacific Electric Railway Company and the Los Angeles Railway Company. A.

NEW ORLEANS, LA.—The assets of the Consumer's Electric Company, amounting to $1,250,000, were recently bought by a reorganization committee representing the bondholders. The reorganized concern will be called The Consumers' Electric Light and Power Company and Samuel Insull, receiver of the old concern, will become president. A bond issue of $1,650,000 at 5 per cent, running thirty years, will be floated by the reorganized company. The new company will take over the plant January 20, and an election of officers will follow February 1.

VALLEJO, CAL.—The Northern California Power Company has announced its intention of extending its lines southward so that the cities about the bay may be supplied with electric power. According to recent plans the line will be extended from Willows to Woodland and from that city to Vallejo. From this city cables will be run across the straits to Contra Costa County and the power carried on down to Oakland and from that city to the metropolis. This company is now running a line to Orland where it is to pump water for the government irrigation project at that point.

INDIANAPOLIS, IND.—The Southern Indiana Power Company, with a capital stock of $800,000, has been incorporated with T. N. Stilwell, F. E. Matson, W. J. Henley, E. E. Gates and Gustav H. Mueller, all of this city, as directors. The company is formed to construct power-stations in the Indiana coal fields, for the purpose of supplying light, heat and power to coal field communities and to communities at a distance from the coal fields. The first station, as now planned, will be constructed in or near Bedford, where the coal can be obtained at the doors of the plant. Other plants may be constructed as the business develops, it was said.

MARBLE FALLS, TEX.—Charles A. Alexander and associates who are erecting a dam across the Colorado River at this place and installing a hydroelectric plant have adopted plans for building another dam across the river near here and a third one is contemplated, the latter to be located at Austin. At each of these additional proposed dams hydroelectric plants will be installed. It is stated by Mr. Alexander that he has already entered into contracts with the cities of San Antonio and Waco and several smaller towns, situated within a radius of one hundred miles of Marble Falls for the sale of light and power and that he is now negotiating with the municipal commission of Austin for a contract of similar character. D.

BOISE, IDAHO.—The Telluride Power Company, the Great Shoshone Falls Light and Power Company and the Boise Power, Light & Traction Company are seeking to gain control of the electric power business of southern Idaho. The Telluride Power Company claims that it is prepared to spend several million dollars in the completion of its Idaho plans. General Superintendent A. L. Woodhouse, of this Company, announces that the main plant of the Telluride Company will be constructed near the confluence of the Malad and Snake Rivers and will furnish 10,000 horsepower to a line to run east and west across southern Idaho. The Shoshone Company is backed by Kohn Brothers. Its plant is on the Malad River at Salmon Falls. A.

SAN FRANCISCO, CAL.—The Yosemite Power Company has been incorporated with a capital stock of $10,000,000. John Hays Hammond, who is at the head of this new corporation, plans to absorb two of the largest power companies in northern California. The Tuolumne Light & Power Company and the Tuolumne River Power Company, which is controlled by eastern capitalists, among whom is Chas. D. Shaw, a Maine timber man. These two companies have a total capacity of 100,000 horsepower, which exceeds by 60,000 horsepower the largest electric corporation on the Coast. Jointly, the two companies own and control practically all the upper Tuolumne watershed. A.

ELECTRIC RAILWAYS.

(Special Correspondence.)

STOCKTON, CAL.—The San Joaquin Electric Railway has applied for a franchise over McKinley Avenue, which reaches to the water front and would give the new line a considerable freight business. A.

PIERRE, S. D.—The Omaha & Western Iowa Traction Company has been incorporated with a capital stock of $180,000. The incorporators are C. W. Brown, M. E. Gallian, C. D. McDonauf, D. J. Avery and J. S. Sebree.

CLEVELAND, O.—Owing to the fact that the Wall Street interests refuse to advance money to the Cleveland Railway Company unless the fare is raised from three to five cents, it is possible that this change may be made.

SAN FRANCISCO, CAL.—H. D. Connick, chief assistant of the City Engineer, reports that construction work on the Geary Street municipal electric road will begin in March. It is proposed to secure coaches constructed entirely of steel, of the most improved type, and fitted for a "pay-as-you-enter" system.

AUSTIN, TEX.—The Austin Street Railway Company has just been reorganized and its capital stock increased to $1,250,000. It will make important extensions and improvements to its city electric street railway system. The incorporators of the reorganized company are R. C. Story of Boston, Mass.; William G. Bell and W. H. Folts of Austin. D.

HIBBING, MINN.—Duluth and eastern capitalists will construct an electric road to Chisholm, Mountain Iron, Buhl, Virginia, Eveleth and Gilbert, to be extended later on to Nashwauk, Bovey, Colerain and Grand Rapids. The electric power will be furnished by the Great Northern Power Company of Duluth. The cost of construction is estimated at 1,250,000. C.

KANSAS CITY, MO.—The City Council has passed an ordinance granting to the Intercity Viaduct & Freight Railway Company a thirty-year franchise for an electrical switching system in the North End wholesale district. The Intercity Viaduct never has been a paying proposition, but with the switching system in connection it is believed that investors will soon begin to realize. The viaduct connects Kansas City, Mo., and Kansas City, Kans. It is a mile long and cost nearly $2,000,000.

GUANAJUATO, MEX.—Arrangements are being made by a French syndicate, represented by E. Brunel, French consular representative at Irapuato, Mex., for the construction of an extensive system of interurban electric railways in the State of Guanajuato. The syndicate is negotiating for the purchase of the street railways of the city of Guanajuato, an offer of $600,000 Mexican currency having been made Gov. Obregon Gonzales, the principal owner, for the property. The syndicate has already acquired the concession for the construction of the Morelia & Tacambaro Railway, the grade for which is partly finished. It is planned by Mr. Brunel and associates to construct a system of electric railways to unite the cities of Leon, Guanajuato and Irapuato. More than sixty miles of track will be built, exclusive of the street railway systems in the three cities which the syndicate is arranging to obtain control. The syndicate pledges itself to expend not less than $4,000,000 gold in the fulfillment of the project. D.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

ELK CREEK, WIS.—The Elk Creek Telephone Company has incorporated with a capital stock of $8,000. P.

FREMONT, WIS.—The Fremont Telephone Company has incorporated with a capital stock of $7,000. P.

CORNELL, WASH.—The Enterprise Telephone Company has been organized to build a line seven miles long. P.

ALLERTON, IOWA.—The Allerton Telephone Companay has been incorporated with a capital stock of $10,000. P

MONTICELLO, ILL.—The Piatt County Telephone Company has increased its capital stock from $10,000 to $50,000. Z.

SEARGENT BLUFFS, IOWA.—The Woodbury County Telephone Company will operate a telephone exchange here. C.

ELKADER, IOWA.—The Boardman-Wagner Telephone Companay has been incorporated with a capital stock of $1,600. P.

FERGUS FALLS, MINN.—The Edwards Telephone Company, E. M. Nelson secretary, has been organized to construct a telephone system in the town of Friberg and adjoining townships. C.

OENAVILLE, TEX.—The Oenaville Rural Telephone Company has been incorporated with a capital stock of $1,000. The incorporators are T. P. Aycock, J. S. Ross and W. S. Elliott. Z.

LEXINGTON, OKLA.—The Good Service Telephone Company has been incorporated with capital stock of $15,000. The incorporators are E. M. Abernathy and R. P. Wyne, of Lexington; J. L. Abernathy, Purcell; and W. F. Wiley, Oklahoma City. Z.

SHELBYVILLE, ILL.—E. M. Harwood has sold his interests in the properties of the Shelby County Telephone Company to Dr. W. J. Eddy. Mr. Harwood will continue as manager until February 1, 1911. Z.

KYLE, TEX.—A temporary organization of the Kyle Telephone Company has been effected. A committee composed of J. W. Wood, of San Marcos, and C. F. Heidenrich and T. F. Harwell, of Kyle, was appointed to take over and hold the exchange property here recently built by G. T. Howe, of Buda, until a permanent organization can be arranged. Z.

GREENSBURG, IND.—The proposed consolidation of the Bell and Independent telephone companies in this city has been abandoned, and the agreement papers returned to each company. The Bell company is now looking for suitable quarters in which to locate an exchange and install new switchboards. New lines radiating from this city seven miles in all directions will be built.

SAVANNA, ILL.—Directors of the Carroll County Independent Telephone Company voted $29,000 for improvements in the city. Of this amount $15,000 will be used to erect a new double building, two stories in height. The switchboards and general offices of the company will occupy the upper floor. The sum of $14,000 has been allotted for the purchase of a new central-energy switchboard and other equipment. Z.

CERRO GORDO, ILL.—The Cerro Gordo Telephone Company has finished the work of placing its lines underground and other improvements to its properties costing $15,000. The changes include a new switchboard costing $2,500. The officers of the company are: President, Dr. Oscar Yarnell, Decatur; vice-president, George H. Eckard, Decatur; secretary, Melvin Welty, Cerro Gordo; treasurer, B. F. Huff, Cerro Gordo; and business manager, A. C. Doyle, Cerro Gordo. Z.

MARQUETTE, MICH.—Improvements under way by the Michigan State Telephone Company include new copper circuits from Menominee to Powers; Menominee to Escanaba; Escanaba to Marquette; Marquette to Munising, and Marquette to Negaunee and Ishpeming. The switchboard at Gladstone has been rebuilt. The line is being extended at Escanaba to Wells, a suburb. The cables from Calumet will lead, when finished, to Centennial, Wolverine, Ahmeek, Copper City, Mohawk and Lake Linden. Z.

ELECTRICAL SECURITIES.

Contrary to the expectations of many, the regular January rise in values was again realized this year, and although the market was not so active as during the corresponding weeks of last year there was a marked improvement over the preceding week. Although the two greatest interests of the country—transportation and steel—are held in check awaiting action of the Interstate Commerce Commission and all the great industrials and trading corporations are in a similar state of suspense pending decisions by the Supreme Court, a great volume of business is being done.

According to a statement made in the New York *Sun*, in the past two years the sale of securities by subsidiary companies of American Telephone and Telegraph has been a feature of public utility financing. In addition to the $34,000,000 bonds and notes sold by the Pacific Telephone & Telegraph Company there was sold in 1909, 25,000,000 bonds of the New York Telephone Company and in 1910, 25,000,000 more. In 1910 also there were sold $10,000,000 notes of the Western Telephone Company and $10,000,000 bonds of the Southern Bell Telephone Company. In the same period also the Western Union has been acquired by the American Telephone & Telegraph. Altogether the Company has a record of greater expansion in the past two years than has any other.

South Side Elevated books close January 21 to 26, inclusive, for the annual meeting, January 26.

The Empire District Electric Company's gross earnings for December, 1910, increased sixteen per cent over November.

The annual meeting of the Brooklyn Rapid Transit Company will be held at noon, January 27, in Brooklyn. Books closed January 10, and will reopen the day succeeding final adjournment of the meeting.

Northwestern Elevated total traffic for 1910 was 44,369,249, against 41,539,574; daily average, 121,559, against 113,809; increase, 6.81 per cent. December traffic of 3,936,662 fares exceeded all previous records.

Gross earnings of Boston Elevated in December did something to atone for the unsatisfactory November increase. The December gain of $63,000, or slightly better than five per cent, compared with an increase in November of 10,100, or but 0.82 per cent, and a $44,000, or three and one-half per cent increase in October. The December increase almost duplicates the September advance in gross of $64,800.

The Pacific Telephone and Telegraph Company, one of the largest subsidiaries of the American Telephone and Telegraph Company, and operating on the Pacific coast, has sold $5,000,0000 two-year five per cent gold coupon notes to Bond & Goodwin, who have resold the entire issue at private sale, largely to institutions in New York, New England and the West. The notes were issued to provide for new construction during the present year.

DIVIDENDS.

American Light & Traction Company; common quarterly divi-

dend of two and one-half per cent; common (stock) dividend of two and one-half per cent; preferred quarterly dividend of one and one-half per cent, all payable February 1.

Boston Elevated; regular semi-annual dividend of three per cent; payable February 15 to stock of record February 4.

East St. Louis & Suburban; preferred quarterly dividend of one and one-quarter per cent, payable February 1.

Gary & Interurban Railway Company; regular quarterly dividend of one per cent, payable January 10 to stock of record January 1.

Pacific Coast Power Company; regular semi-annual dividend of two and one-half per cent and an extra dividend of one-half of one per cent on the common stock; regular semi-annual dividend of three per cent on the preferred; all dividends payable January 16 to stock of record January 6.

Railway & Light Securities Company; preferred semi-annual dividend of three per cent; common semi-annual dividend of two per cent, both payable February 1.

Standard Underground Cable Company; regular quarterly dividend of three per cent, an extra dividend of three per cent, and a special dividend of five per cent, payable January 11 to stock of record January 5.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.

	Jan. 9.	Jan. 2.
Allis-Chalmers common	8	8
Allis-Chalmers preferred	29	27
Amalgamated Copper	65⅜	61½
American Tel. & Cable	83	*78
American Tel. & Tel.	141⅝	140
Brooklyn Rapid Transit	75¾	74⅞
General Electric	151½	151¼
Interborough-Metropolitan common	19⅞	19½
Interborough-Metropolitan preferred	54⅞	53½
Kings County Electric	123	123
Mackay Companies (Postal Telegraph and Cables) common	92	90
Mackay Companies (Postal Telegraph and Cables) preferred	74¾	74¾
Manhattan Elevated	140	138½
Metropolitan Street Railway	*18	*18
New York and New Jersey Telephone	103	103
U. S. Steel common	74¼	43½
U. S. Steel preferred	118⅛	116⅝
Western Union	75	72½
Westinghouse common	64	65½
Westinghouse preferred	100	115

*Last price quoted.

BOSTON.

	Jan. 9.	Jan. 2.
American Tel. & Tel.	141½	140¼
Edison Elec. Illuminating	280	280
General Electric	151½	151¼
Massachusetts Electric common	18	18
Massachusetts Electric preferred	84¼	85
New England Telephone	138	138
Western Tel. & Tel. common	17	17
Western Tel. & Tel. preferred	91	91½

PHILADELPHIA.

	Jan. 9.	Jan. 2.
American Railway	42	42
Electric Company of America	11⅝	11⅝
Electric Storage Battery common	49½	48
Electric Storage Battery preferred	49½	48
Philadelphia Electric	16⅜	16
Philadelphia Rapid Transit	19¼	18⅝
Philadelphia Traction	84	82½
Union Traction	44¾	43

CHICAGO.

	Jan. 9.	Jan. 2.
Chicago Railways, Series 1	95	97
Chicago Railways, Series 2	24	25
Chicago Subway	4¼	4½
Chicago Telephone	120	120
Commonwealth Edison	113½	113½
Metropolitan Elevated common	21	22½
Metropolitan Elevated preferred	68	68
National Carbon common	117	118
National Carbon preferred	115	115

PERSONAL MENTION.

R. L. JOHNSTON, superintendent of the Light Department of the Northern Ohio Traction & Light Company, of Akron, O., was a visitor at the Chicago Electrical Show this week.

H. W. CHASE, commercial manager of the Union Gas & Electric Company, of Cincinnati, O., has resigned to accept a position with the Central Station Development Company of Cleveland.

C. R. LAUB, of Morris, Ill., has been made district manager and superintendent of the electrical department for the territory including Wilmington, Gardner, Dwight, South Wilmington, Odell, Mazon and Coal City.

RALPH S. POWLEY, auditor and general passenger agent of the Toledo, Fostoria & Findlay Traction Company, recently resigned to enter the insurance business. Mr. Powley has been connected with the Traction Company for the past six years.

ROBERT MATHER, chairman of the board of directors of the Westinghouse Electric & Manufacturing Company, is at present on a trip abroad. He will spend a large part of his time in examination of the properties of the foreign Westinghouse companies.

M. B. CHASE has resigned his position in the detail and supply sales department of the Westinghouse Electric & Manufacturing Company, at its Boston office, to accept the position of New York manager for the Sangamo Electric Company of Springfield, Ill. Mr. Chase's offices will be in the Hudson Terminal Building.

A. N. FOX, manager of the publicity department of the Benjamin Electric Manufacturing Company, Chicago, has been elected chairman of the "Round Tablers," a newly organized group of advertising men. The body meets once a week in the rooms of the Chicago Advertising Association for the purpose of a systematic study of the various phases of trade publicity.

P. F. LYONS has, since the first of the year, been established as western representative of the National India Rubber Company, with offices in the People's Gas Building, Chicago. Mr. Lyons enjoys an unusually large acquaintance among the electrical men of the west, gathered during the twelve years he has covered this territory for his company.

F. G. BOLLES, recently commercial engineer of the Allis-Chalmers Company, has purchased the entire interest of C. A. Tupper in the patents and exclusive sales agencies controlled by the Reliance Engineering & Equipment Company, Milwaukee, and has incorporated the Alliance Engineering & Sales Company, with $50,000 capital, to carry on that branch of the business. The consulting work will be retained by the old company under the management of Mr. Tupper.

REGINALD A. FESSENDEN was the subject of a recent injunction issued at the request of several Pittsburg capitalists, with the professed object of preventing him from interfering with the issuance of patents in which they were financially interested. Prior to the injunction, a party of men surrounded the wireless station at Brant Rock, and tried to seize papers from Mrs. Fessenden, who was there alone at the time. Mrs. Fessenden secured help by means of a wireless telegraph set in the station and prevented the attempted seizure of her husband's patents and papers.

CHARLES L. BENJAMIN, advertising manager of the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., is the author of a splendid article entitled "Electric Helps in All Fields" which forms a prominent part of the supplement to the *Evening Wisconsin*, of December 31, 1910. Mr. Benjamin has presented a remarkable survey of the universality of the use of efficient electrical appliances made in Milwaukee. Upon reading this article it is a question as to the direction in which pride should be most indulged—whether Mr. Benjamin should be proud of his achievement, or Milwaukee proud of its possessions of so illimitable an opportunity through its manufacturing industry to add to the resources of the world.

H. A. BENEDICT, electrical engineer of the United Traction Company, Albany, N. Y., was tendered an informal dinner at the Ten Eyck in that city, on the evening of December 31, by some of his associates in Central New York. Mr. Benedict left the United Traction Company on January 1 to assume his new duties as Superintendent of Equipment of the Public Service Railway Company, Newark, N. J. The following were present and tendered Mr. Benedict their sincere regrets at his leaving and expressed their best wishes for his success in his new position: J. P. Barnes, Syracuse Rapid Transit Company; W. J. Harvie, Utica & Mohawk Valley Railway Company; F. J. Doyle, Schenectady Railway Company; E. S. Fassett, United Traction Company; Chas. H. Smith, United Traction Company; M. C. Carpenter, United Traction Company, and H. N. Ransom, C. F. Scott, and C. E. Barry, of the General Electric Company.

OBITUARY.

S. MAYS BALL, Atlanta correspondent of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, died at his home in Atlanta on December 11, 1910, after an illness of only a few days. Mr. Ball was in his thirty-seventh year and was the son of the late Major George C. Ball. He was born in Montgomery, Ala., but spent most of his life in Atlanta. Mr. Ball for years had been one of the South's best known writers, possessing a brilliant intellect, which the leading publications of the country were quick to recognize. He was widely known in Atlanta and as a member of the Capital City Club enjoyed a marked popularity, and his untimely death brings genuine sorrow to a host of friends and acquaintances. He received his schooling at the University of Alabama, going direct to Atlanta, where he opened The Railway Supply House. Soon after embarking in business his health failed and he spent four years in the West recuperating. Upon his return to Atlanta he gave up active business and entered newspaper work. He was a valued correspondent, familiar with electrical affairs in the great Southland, an exponent of the progress being made there, and his conscientious attention to detail will be sadly missed. He is survived by his mother and two sisters, Miss Elise Ball, of Atlanta, and Miss Sue Allen Ball.

PROPOSALS.

POST OFFICE, HILLSDALE, MICH.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until February 3 for the construction, complete (including plumbing, gas piping, heating apparatus, electric conduits and wiring), of the United States post office at Hillsdale, Mich., in accordance with drawings and specifications, copies of which may be obtained from

the custodian of site at Hillsdale, Mich., or at the Supervising Architect's office.

POST OFFICE, WATERTOWN, WIS.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until February 7 for the construction, complete, (including plumbing, gas piping, heating apparatus, electric conduits and wiring), of the United States post office at Watertown, Wis., in accordance with drawings and specifications, copies of which may be obtained from the custodian of the site at Watertown, Wis., or at the Supervising Architect's office.

POST OFFICE, HOLDREDGE, NEB.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until February 2, 1911, for the construction (including plumbing, gas piping, heating apparatus, and electric conduits and wiring), of the United States post office at Holdredge, Neb., in accordance with the drawings and specifications, copies of which may be had from the custodian of the site at Holdredge, Neb., or at the Supervising Architect's office.

FOREIGN TRADE OPPORTUNITIES.

(From *Daily Consular and Trade Reports* issued by the Bureau of Manufactures, Washington, D. C. In replying to the Bureau for information, mention should be made of the file number.)

NO. 6018. WIRELESS TELEGRAPH INSTALLATIONS.—Consul General John P. Bray, of Sydney, Australia, has forwarded proposals, specifications, and general conditions for the installation of wireless telegraphy at Thursday Island, Australia, and Port Moresby, Papua (New Guinea). Tenders will be received until March 14, 1911, by the deputy postmasters general at the capitals of the six States, and the High Commissioner for the Commonwealth of Australia, 72 Victoria Street, Westminister, London, England.

HYDRAULIC IMPROVEMENTS.—The Ministry of Public Works, of Italy, has authorized the expenditure of about $70,000 for hydraulic works in the provinces of Bari, Naples, Lucca, Venice, Ferrara, Forli, Milan, Belluno, and Ravenna. American builders of hydraulic machinery should communicate with the Ministero dei Lavori Pubblici, at Rome, Italy.

NEW PUBLICATIONS.

WASHING AND COOKING TESTS OF COAL.—The tests described in this booklet were carried on between July 1, 1908 and June 30, 1909, and form part of the investigation of mineral fuels carried on by the United States Geological Survey. The general purposes of making the tests was (1) to determine the possibility of improving the quality of various coals by washing, so as to make them available for the production of coke, and (2) to determine the feasability of making coke in beehive ovens from these coals.

NAVY DEPARTMENT REPORTS.—Annual reports for 1910 have been issued by the Bureaus of Navagation, Construction and Repair, Yards and Docks, and Ordnance of the Navy Department. These are concerned principally with routine matters. A list of the vessels in the Navy is included in the report of the Bureau of Construction and Repair. The Chief of the Bureau of Navigation states that all enlisted electricians in the Navy are now supplied by the two electrical classes maintained at Brooklyn and Mare Island. The training in these schools is so good that electricians in the service find no difficulty in securing remunerative employment on shore, and seldom re-enlist.

NEW INCORPORATIONS.

CLEVELAND, O.—The Modern Electric Company has been incorporated with a capital of $5,000. Incorporators are S. J. Deutsch, F. Bernstein, S. J. Rothschilds.

MANGUM, OKLA.—The Mangum Electric Company has been incorporated with a capital of $200,000. The incorporators are E. S. Bessey, L. Rutherford and John C. Keys.

DENVER, COLO.—The Gas & Electric Furnace Company has been incorporated with a capital of $200,000 by W. W. Linninger, J. C. Pelton and C. C. Donaldson, of this city.

SAN FRANCISCO, CAL.—The Sierra Incandescent Lamp Company has been incorporated here by W. H. Taylor, E. H. Fosdick, C. A. Barhydt and others with a capital stock of $50,000. A.

CHICAGO, ILL.—The Interstate Electric Company has been incorporated with a capital of $2,500 to do electrical contracting. The incorporators are C. J. Huff, George M. Hornecker and Mrs. M. B. Huff.

PEORIA, ILL.—The Peoria Electric Fixture Company has been incorporated with a capital stock of $2,400 to manufacture and deal in electrical fixtures, gas and electric supplies. The incorporators are E. J. Abersol, John L. Palmer and A. G. Walsh. Z.

LAPORTE, IND.—The Laporte Meter Company has filed articles of incorporation, the capital stock is $150,000. The object of the incorporation is to manufacture electric and gas meters and other electric and gas devices. Directors are: V. P. Wilkins, Emmett Scott and E. H. Scott. S.

INDUSTRIAL ITEMS.

THE MITCHELL-RAND MANUFACTURING COMPANY has mailed to the trade calendars for the year 1911.

THE HURLEY MACHINE COMPANY, Chicago, has distributed folders bearing a series of comic pictures and advertising Thor electric washing machines.

THE CUTTER ELECTRICAL & MANUFACTURING COMPANY has opened a new sales office at 1418 Ford Building, Detroit, Mich., which is in charge of C. E. Wise, formerly of the Chicago office.

ELMER P. MORRIS & COMPANY, New York, report a very satisfactory condition of business in their export department. During the first week of the year goods were shipped to Japan, the Philippines, South America and Australia.

THE CHICAGO FUSE MANUFACTURING COMPANY, Chicago, Ill., announces that the above name was adopted by the Company on December 31. The concern was formerly known as the Chicago Fuse Wire & Manufacturing Company.

THE PELTON WATER WHEEL COMPANY, San Francisco, Cal., announces that on January 1 its offices, which were formerly located at 1099 Monadnock Building, were consolidated with the works' office, at Nineteenth and Harrison streets.

THE FAIRMOUNT ELECTRIC & MANUFACTURING COMPANY, Philadelphia, Pa., announces that its offices and plant have been moved to a new building at 2203 and 2205 Pearl Street. All correspondence should be addressed to this new office.

THE WAYNE ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has mailed attractive calendars advertising its electric motors. The phrase, "Wagner Quality," is made use of and the same general style is followed out that his been charactersitic of Wagner advertisements.

THE ELMER P. MORRIS COMPANY, New York, N. Y., has been awarded the contract for furnishing 500 posts for tungsten park lighting of the city of New York. About half of these are of a new type and will be used for the lighting of the transverse roads through Central Park, and the balance for regular installations.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has just received an order for one 100-kilovolt-ampere three-phase, sixty-cycle, 480-volt, 900-revolution-per-minute, belted-type generator, a two-panel switchboard and several induction motors to be shipped to the Mina Mexico Company, Tonichi, Sonora, Mexico.

THE GENERAL INCANDESCENT LAMP COMPANY, Cleveland, Ohio, has published a folder bearing the salutation: "I am Glad to See You G. I." The folder contains a little story in which are summarized the advantages of G. I. lamps, and on the last page is a list of forty-two representatives of the General Incandescent Lamp Company.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., has issued the Westinghouse Diary for 1911. This is one of the most valuable reference memorandum books distributed, and it is growing constantly in favor among those receiving it. A system of expense-account sheets makes the new diary particularly valuable to traveling men.

THE EMERSON ELECTRIC COMPANY, St. Louis, Mo., has issued Bulletin No. 3141 on single-phase induction motors ranging in size from one-tenth to one-fifteenth horsepower in rated size. Another bulletin, No. 3708, describes the two styles of lathes designed for the requirements of dentists. Both of these styles of lathes are furnished with chucks and polishing and grinding wheels.

THE BRISTOL COMPANY, Waterbury, Conn., catalogs in its recently issued Bulletin No. 130, a complete line of the standard Bristol pyrometer outfits and also states that in addition to these a variety of special equipments may be furnished to order. The bulletin is well illustrated and contains a number of sample scales, specimen charts and photographic reproductions of smoked charts and semi-transparent smoked charts.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., has recently issued Bulletin No. 1122 on small motors for operation on direct-current circuits, and motors for alternating current. A list of applications for the motor is given and some of these are illustrated. One of the novel uses to which these motors may be put is shown in an illustration of a one-thirtieth horsepower motor belted to a mechanically tilted photographic developing tray.

THE BRISTOL COMPANY, WATERBURY, CONN., has mailed to the trade its new Bulletin No. 130, in which is included descriptions and lists of both indicating and recording electric pyrometers. The catalog contains also explanations of the special patented features as, for instance, the basic patents on means of compensating readings of thermo-electric pyrometers for changes in cold-end temperature. A partial list of more than 700 users of Bristol pyrometers is given in the bulletin.

THE LORD MANUFACTURING COMPANY, which succeeded to the business of the Manufacturing Department of the Lord Electric Company on June 1, 1910, just closed the year 1910, with

more business on hand, and with a better record than the manufacturing or railroad department of the Lord Electric Company had ever before made. Its business during the year has covered nearly every country on the globe. The growth of this company's business is most gratifying, and the results most satisfactory. It has added on its books the largest number of customers in its history. Its business has become more general; a larger number of products being constantly called for by far, than during any previous year. This company begins the year 1911 with sufficient business in hand, and contracts for future delivery, to keep busy for several months.

THE SANGAMO ELECTRIC COMPANY, Springfield, Ill., announces that a New York office has been opened in the Hudson Terminal Building, with M. B. Chase as New York manager, in charge. The New York office will be fully equipped from both an engineering and sales standpoint so that a large part of the work, especially that for devices to meet the special conditions formerly referred to the Factory will be handled direct from New York. A new Factory is practically completed at Springfield which will enable the Sangamo Company to take care of their very rapid increasing business. The above company is distributing a series of bulletins showing the elements of its mercury-flotation ampere-hour and watt-hour integrating meters. The detailed drawing illustrating the non-spillable mercury chamber should be of interest to meter superintendents. Some of the meters of the type described have been sent to Manila, P. I.

THE ALLIANCE ENGINEERING & SALES CO., Milwaukee, Wis., lists in Bulletin No. 100 several concerns with which it has contracts for the exclusive sale of Alliance products in Wisconsin and the Michigan Peninsula. The company will supply nearly anything that may be required in the mechanical, electrical or hydraulic field.

DATES AHEAD.

Chicago Electric Show. Coliseum, Chicago, Ill., January 7-21.

Indiana Engineering Society. Annual meeting, Indianapolis, Ind., January 12, 13 and 14.

Electrical Contractors' Association of New York State, Annual meeting, Albany, N. Y., January 16.

Wisconsin Electrical Association. Annual convention, Milwaukee, Wis., January 18-19.

National Independent Telephone Association. Annual Convention, Chicago, Ill., January 18-19.

Canadian Electrical Association. Special general meeting, Toronto, Can., January 20.

Minneapolis Electrical Show, Minneapolis, Minn., January 26, February 4.

Philadelphia Electric Show. Philadelphia, Pa., February 13-27.

Iowa Electrical Association. Annual meeting, Davenport, Iowa, April 19, 20 and 21.

Directory of Electrical and Allied Engineering and Scientific Societies

(Published in the second issue of each month.)

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AMERICAN ASSOCIATION OF ELECTRIC MOTOR MANUFACTURERS. Secretary, W. H. Tapley, 29 West Thirty-ninth Street, New York, N. Y.

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AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, H. C. Donecker, 29 West Thirty-ninth Street, New York, N. Y. Affiliated societies: American Electric Railway Accountants' Association, secretary, H. E. Weeks, Davenport, Iowa; American Electric Railway Claim Agents' Association, secretary, B. B. Davis, Columbus Railway & Light Company, Columbus, O.; American Electric Railway Engineering Association, secretary, Norman Litchfield, New York, N. Y.; American Electric Railway Transportation and Traffic Association, secretary, H. C. Donecker, 29 West Thirty-ninth Street, New York, N. Y.; American Electric Railway Manufacturers' Association, secretary, George R. Keegan, 2321 Park Row Building, New York, N. Y.

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OLD-TIME TELEGRAPHERS' AND HISTORICAL ASSOCIATION. Secretary, Frank J. Sherrer, 195 Broadway, New York, N. Y.

ORDER OF THE REJUVENATED SONS OF JOVE. Mercury, Roy M. Van Vliet, Monadnock Block, Chicago, Ill.

PACIFIC COAST ELECTRIC VEHICLE ASSOCIATION. Secretary, A. H. Halloran, 901 Atlas Building, San Francisco, Cal.

PENNSYLVANIA ELECTRIC ASSOCIATION. Secretary, Van Dusen Rickert, Pottsville, Pa.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 135 South Second Street, Philadelphia, Pa.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Colo.

PITTSBURG ELECTRIC BOOSTERS' CLUB. Recording Wattmeter, O. R. Rombach, 919 Liberty Avenue, Pittsburg, Pa.

RAILWAY ELECTRIC SUPPLY MANUFACTURERS' ASSOCIATION. Secretary, J. Scribner, General Electric Company, Chicago, Ill.

RAILWAY SIGNAL ASSOCIATION. Secretary, C. C. Rosenberg, Bethlehem, Pa.

SOCIETY OF THE UNITED STATES MILITARY TELEGRAPH CORPS. Secretary, David H. Bates, 658 Broadway, New York, N. Y.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y.

SOCIETY OF AUTOMOBILE ENGINEERS. Secretary, Alexander Churchward, 30 Church Street, New York, N. Y.

SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, E. D. Forbes, 96 Franklin Street, South Framingham, Mass.

SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, E. R. Buck, Hudson, S. D.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, W. B. Head, Stephensville, Tex.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW

YORK. Secretary, J. H. Pardee, J. G. White & Company, New York, N. Y.

TELEPHONE SOCIETY OF NEW YORK. Secretary, T. H. Lawrence, Eighteenth Street and Irving Place, New York, N. Y.

TEXAS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Leon Spencer, Gainesville, Tex.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 141 Milk Street, Boston, Mass.

UTAH SOCIETY OF ENGINEERS. Secretary, W. C. Ebaugh, University of Utah, Salt Lake City, Utah.

VERMONT AND NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, E. B. Seeley, St. Johnsburg, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, A. B. Marsden, Manchester, Vt.

WASHINGTON SOCIETY OF ENGINEERS. John C. Hoyt, 1330 F Street, Washington, D. C.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 125 Monroe Street, Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS. Secretary, J. H. Warder, Monadnock Block, Chicago, Ill.

WISCONSIN ELECTRICAL ASSOCIATION. Secretary, John S. Lake Geneva, Wis.

WISCONSIN INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. C. Crowley, Jr., Superior, Wis.

WISCONSIN STATE TELEPHONE ASSOCIATION. Secretary, Paul J. Weirich, Monroe, Wis.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) January 3, 1911.

980,183. SYNCHRONOUS DYNAMO-ELECTRIC MACHINE. Jens. Bache-Wiig, Edgewood Park, Pa., assignor to Westinghouse Electric & Manufacturing Company. Filed February 3, 1910. The poles of a synchronous motor are provided with copper bars set in peripheral transverse slots. The bars constitute parts of a closed-circuit winding, the bars near the edges of the polar projections being of lower resistance than those near the centers.

980,200. SECTION BREAKER AND INSULATOR. William T. Carns and Troy L. Brown, Red Jacket, W. Va. Filed May 6, 1909. A section breaker is composed of two opposed separated terminal caps, each having a longitudinal vertical socket for the reception of an insulating section, one of the caps having spaced extensions projecting from its upper portion, the other being formed with spaced extensions projecting from its lower portion, the extensions of one member being adapted to longitudinally overlap the extensions of the other, and the outer ends of the caps being provided with means for engaging line wires.

980,221. ELECTRIC SWITCH. Arthur C. Eastwood, Cleveland, Ohio, assignor to Electric Controller & Manufacturing Company, Cleveland, Ohio. Filed September 27, 1906. Is mounted on a supporting frame on which a switch member is pivoted. A solenoid mounted on the frame has a plunger connected to the switch member, and a stationary laminated contact is mounted on the frame and arranged to engage the switch member at a point contiguous to its connection with the plunger of the solenoid.

980,256. VILLAGE TELEPHONE POLICE-CALL. George Washington Herrick, St. Marys, Pa. Filed March 20, 1908. A police call is arranged to operate in connection with the telephone circuit.

980,259. ELECTRIC INDUCTION SMELTING-FURNACE. Karl Albert Fredrik Hiorth, Christiania, Norway. iled May 18, 1910. An annular furnace groove is combined with a hollow magnet core placed inside the furnace. The primary winding is set between the hollow core and the furnace groove.

980,265. ELECTRICAL SYSTEM OF DISTRIBUTION. Albert S. Hubbard, Belleville, N. J., assignor to Gould Storage Battery Company. Filed December 17, 1908. Covers the combination of an alternating-current source, a direct-current source, an alternating-current work circuit fed from the former source, a motor-generator connecting the sources, and means for varying the field strength of the direct-current end of the motor-generator, to maintain the speed substantially constant while driven from the direct-current side of the system.

980,286. COIL-RETAINING MEANS. Patrick Kennedy, New York, N. Y., and Joseph A. Misland, Bayonne N. J. Filed May 15, 1909. The method of securing conductors in slots of dynamo-electric machines consists in inserting a metallic wedge or key in the slot after the coils are in place, and then expanding the metal of the wedge or key at intervals, so as to produce lateral projections from the main body portion thereof sufficient to secure it in its coil-retaining position.

980,288. TIME-SWITCH. Arthur W. Koiner, Richmond, Va. Filed July 9, 1910. A clock dial is provided with a pair of insulating dial rings upon which a conducting block is movably mounted. A spring hand resting on the block completes the circuit, this hand being pushed off the block at a predetermined time and the circuit broken.

980,302. CONTROLLING DEVICE FOR ALTERNATING-CURRENT MOTORS. David Leonard Lindquist, Yonkers N. Y., assignor to Otis Elevator Company, Jersey City, N. J. Filed May 26, 1905. An induction motor is provided with a secondary resistance, opposing magnets being connected respectively to the primary and secondary of the motor, and means controlled by the magnets for varying this resistance.

980,307. BODY FOR ELECTRIC-LIGHT FIXTURES. Wilfrid Lumley, East Conneaut, Ohio, assignor to Conneaut Company. Filed January 27, 1909. Comprises a central supporting band having on its upper face a narrow arched bridge with a receiving socket, and on its lower face a second narrow arched bridge also provided with a receiving socket, the entire space between the inner walls of the supporting band and the inner walls of the arches being free from obstruction.

980,308. EXTENSIBLE LIGHT-FIXTURE. Wilfrid Lumley, East Conneaut, Ohio, assignor to The Conneaut Company. Filed January 27, 1909. A fixture for electric lights comprises an upper securing plate and a lower supporting member, the upper member having a pair of peripheral flanges of variable depth extending toward the other member, which other member is provided with a bearing edge extending toward the first member and between the two flanges and a plurality of extensible tubes adapted to hold electric light wires.

980,336. AUTOMATIC STREET-INDICATOR. Alexander C. Richheimer and Paul W. Koch, Chicago, Ill. Filed March 30, 1910. A web imprinted with the names of the various streets is wound on rollers which are actuated by solenoids. Means are provided for the operation of the solenoid by the conductor.

980,338. HAULAGE-LOCOMOTIVE. John M. Roan, Dante, Va. Filed December 30, 1908. Includes a motor, means for transmitting motion from the motor to the locomotive, a reel, a haulage cable carried by the reel, means for transmitting motion from the motor to the haulage cable reel, a second rotatably mounted reel, an electric-current-conducting cable carried on the second reel and means for transmitting motion from the motor to the electric cable reel in either direction.

980,344. TROLLEY. Frank N. Russell, Elmira, N. Y. Filed May 16, 1910. Bearing blocks are screwed into the openings of a trolley fork and journals are mounted in the blocks, a hollow bolt passing through the wheel and connecting the blocks together, an oil-supplying duct leading into the interior of the bolt from the outward side of one of the blocks and ducts leading from the interior of the bolt to the bearing surfaces on each of the blocks.

980,356 to 980,359. MULTIPLEX TELEPHONY AND TELEGRAPHY. George Owen Squier, United States Army. Filed November 5, 1910. (Dedicated to the public.) These four patients relate to the multiplex system described in some detail on page 97 of this issue.

980,364. PROCESS OF SEPARATING MERCURY FROM POOR ORES BY ELECTROLYSIS. Bela Szilard, Paris, France, assignor to Bela Szilard and Henry Bergerat, Paris, France. Filed June 22, 1910. Consists in treating a finely-divided ore with a lixiviating agent comprising a mixed solution of sodium chloride and calcium sulphide and then subjecting the solution to electrolytic action.

980,369. MANUFACTURE OF STEEL. William R. Walker, New York, N. Y. Filed January 2, 1909. Consists in treating the metal in an open-hearth-furnace or Bessemer converter, then withdrawing the steel thus formed into a movable vessel with the desired alloy additions, electrically heating the steel in said vessel to maintain it in a molten condition and allowing the additions to take effect and permit rise of impurities to the surface and escape of gases, and then pouring direct from the electrically heated vessel into mold.

980,380. ELECTRIC SIGNALING APPARATUS. Roy A. Wilhite, Indianapolis, Ind. Filed January 6, 1910. A signaling device includes three circuits, one of which operates a pair of electromagnets. A second circuit is normally closed and a third circuit is so arranged that when closed it sends current constantly through the magnet.

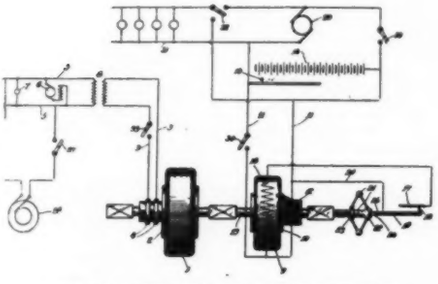
980,417. AUTOMATIC-EXCHANGE SELECTOR. Howard B. Holmes, Park Ridge, and Edward B. Craft, Chicago, Ill., assignors to Western Electric Company, Chicago, Ill. Filed March 8, 1906. A selector switch comprises a bank of fixed contacts

arranged in parallel rows, a group of brushes corresponding respectively to the different rows of fixed contacts and electrically connected in multiple, a movable support common to the brushes, means for selectively advancing any of the brushes into mechanically co-operative relation to the corresponding row of fixed contacts, and means for imparting to the brush support a movement of translation to carry the selected brush along the corresponding row of fixed contacts, in the plane of its first-mentioned movement.

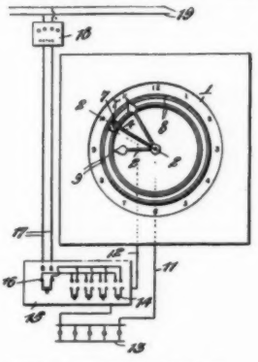
980,438. LAMP-SOCKET. Henry E. Reeve, New York, N. Y. Filed May 12, 1908. The cap member has a limited portion of one edge turned inward to form one member of a hinge, one of the shoulders forming the other member.

980,465. AUTOMATIC ADJUSTABLE HOLDER FOR TELEPHONE INSTRUMENTS. Frank S. Weyrs, Philadelphia, Pa. Filed April 19, 1909. A telephone instrument is mounted in an adjustable base, and means are provided for actuating the switch hook by revolving the adjustable base.

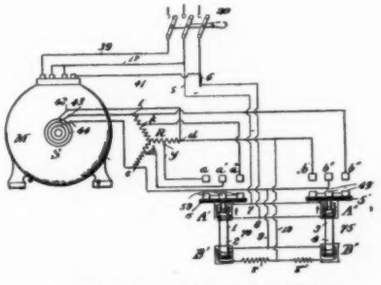
980,475. MOTOR-CONTROLLED SWITCH. Alfred James Barlow, Tottenham, England, assignor of two-thirds to Electromotor Equipment Company, Limited, London, England. Filed December 4, 1909. This apparatus combines a main motor, a rotatable member provided with contacts adapted to control the circuit, an auxiliary motor directly geared to the rotatable member to actuate it, a switch controlling the auxiliary motor, means



980,265.—SYSTEM OF DISTRIBUTION.



980,288.—TIME SWITCH.



980,302.—CONTROLLING DEVICE.

actuated by the rotatable member of closing the circuit of the main motor and means controlled by the switch for maintaining the first mentioned means in its operative position.

980,522. MEANS FOR OPERATING BRIDGES AND THE LIKE. Daniel Howard Haywood, New York, N. Y. Filed July 26, 1910. Means for operating ferry bridges and the like comprise a motor for raising and lowering the bridge, a float, means operated by the float in its movement to start the motor, and means operated by the bridge in its movement to stop the motor.

980,526. ELECTRIC-RAILWAY SYSTEM. Charles A. Huse, Williamsport, Pa., and Spencer M. Bowman, New York, N. Y., assignors to International Surface Contact Company, Philadelphia, Pa. Filed February 3, 1910. A surface-contact railway has two electro-magnets mounted one on each side of the collector on the car. The front one closes the circuit in the switch boxes along the track and the rear one opens it.

980,540. SYSTEM OF ELECTRIC TRACTION. Owen E. Longsdorf, Crafton, Pa. Filed July 23, 1909. A switch box for a surface-contact system contains a series of contact-making armatures mounted on pivoted arms.

980,541. DEVICE FOR CONTROLLING ELECTRIC CIRCUITS. Pierre Lorillard, Tuxedo Park, N. Y. Filed January 29, 1907. A series of independently movable adjoining switches has means attached to the intermediate ones for limiting the movement of its neighbors.

980,557. LOCKING MECHANISM FOR ROTARY SNAP ELECTRIC SWITCHES. Johann G. Peterson, Hartford, Conn., assignor to Arrow Electric Company, Hartford, Conn. Filed September 23, 1910. Includes a locking plate with lugs engaging a ratchet.

980,559. ELECTRIC SWITCH. Clarence D. Platt, Bridgeport, Conn. Filed May 31, 1910. Has contacts formed of sheet metal, with opposed plates, a number of interengaging projections and perforations in the plates and binding means co-operating with the projections.

980,566. SPARK PLUG. Albert Schmidt, Flint, Mich, assignor to Champion Ignition Company, Flint, Mich. Filed June 9, 1910. Relates to details of construction.

980,580. ELECTRIC-LIGHT ATTACHMENT. James Allan Williams, Montreal, Quebec, Canada. Filed June 14, 1909. Consists of a clamp supporting a post and a number of jointed telescopic extensions.

980,598. ILLUMINATING DEVICE FOR OVENS. Thomas Cascaden, Jr., Waterloo, Iowa. Filed April 18, 1910. The doors of the oven has a peep hole and within the oven is an electric lamp.

980,600. CUTTER FOR CABLE ARMOR AND TUBING. Lewis H. Church, Stamford, Conn. Filed April 27, 1907. A tubular casing is arranged to grip the armor and permit a cutting tool to revolve about it.

980,613. TELEPHONE SYSTEM. William W. Dean, Elyria, Ohio, assignor to Dean Electric Company, Elyria, Ohio. Filed July 31, 1909. The iron core of the receiver-magnet has two windings, one in the transmitter circuit and the other in the line circuit.

980,619. LOCKING DEVICE FOR THE RECEIVER-ARMS OF TELEPHONES. William R. Ewing, Mars, and Charles P. Ewing, Renfrew, Pa. Filed April 29, 1910. The shaft of a magneto is arranged to release a locking device for the arm when rotated.

980,620. AUTOMATIC ELECTRIC SWITCHING MECHANISM. John James Fanning, Cantley, Quebec, Canada, assignor of one-half to Thomas Ferris Nellis, Ottawa, Canada. Filed February 17, 1910. An electric track switch.

980,639. ARC LAMP. Charles A. Hughes, Terre Haute, Ind. Filed July 5, 1910. A projecting lantern has means for moving the electrode vertically, transversely and laterally for adjustment.

980,690. TELEPHONE-RENT-COLLECTING DEVICE. Henry R. C. Spencer, Granville, N. Y. Filed June 21, 1910. A prepayment device, with a number of coin chutes, each electrically connected to the line.

980,703. INCANDESCENT LAMP. Elihu Thomson, Swampscott, Mass, assignor to General Electric Company. Filed October 12, 1908. A metal-filament lamp has coiled wire springs for supporting the filament-holding frame and leading current into the filament.

980,707. MOTOR CONTROL. John F. Tritle, Schenectady, N. Y., assignor to General Electric Company. Filed July 15, 1908. Comprises electro-magnetically-controlled switches for connecting portions of resistances in parallel and then short-circuiting them.

980,709. RAILWAY SIGNALING SYSTEM. Ralph P. Tuttle, New York, N. Y., assignor to Union Switch & Signal Company, Swissvale, Pa. Filed July 29, 1909. An electric block-signal system.

980,723. SPARK PLUG. Peter M. Wilson, Providence, R. I., assignor of one-half to James M. R. Taylor, Providence, R. I. Filed September 24, 1909. Relates to the manner of mounting the inner detachable electrode.

980,763. ELECTRIC FURNACE FOR THE CONTINUOUS EXTRACTION OF ZINC FROM ITS ORES. Eugene François Cote and Paul Rambert Pierron, Lyon, France. Filed August 13, 1908. Consists of a closed annular retort, a condenser formed by a vertical cylinder arranged in the axis of the furnace, an upper electrode formed by a block of graphite arranged in the axis of the retort, and a lower electrode placed at the center of the condenser.

980,767. MACHINE FOR FORMING LOOPS FOR SUPPORTING FILAMENTS OF ELECTRIC LAMPS. John T. Fagan, Cleveland, Ohio, assignor to National Electric Lamp Company. Filed January 29, 1909. Has a gripping tongs and means for giving it a forward, a lateral and a turning movement.

980,770. WIRE-CONNECTOR. Anton Freier, Boston, Mass., assignor to Heltzer-Cabot Electric Company. Filed January 18, 1909. A seamless-drawn tube shaped like the figure 8 and adapted to receive the ends of the wires and then twisted.

980,781. ELECTRIC MELTING FURNACE. Karl Albert Fredrik

Hiorth, Christiania, Norway. Filed July 28, 1909. The large sub-divided secondary windings of a transformer are connected to the melting chamber, which is of reduced area, to increase the resistance.

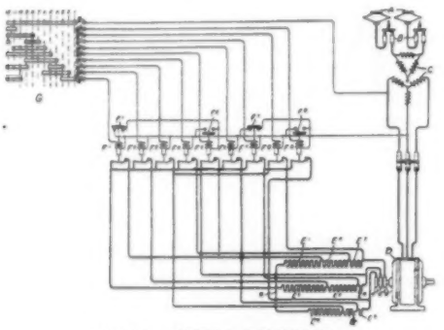
980,805. ELECTRIC-LAMP-HOLDING SOCKET. Harry W. Lawrence, Denver, Colo. Filed July 24, 1908. A locking socket.

980,812. AUTOMATIC ELECTRIC CIRCUIT BREAKER. William F. Meter and William L. Rideout, Oshkosh, Wis., assignors to Electrical Manufacturing Company, Oshkosh, Wis. Filed March 30, 1908. The solenoid is mounted back of the switchboard and its plunger strikes a pivoted hammer passing through the board and opening the switch.

980,830. BATTERY AND HOLDER. George Lewis Patterson, New York, N. Y., assignor to Alice C. Patterson, New York, N. Y. Filed May 26, 1908. In the top of the battery box are two sets of spring clips, one for engaging the central positive terminals of the dry cells and the other for contacting with the negative cell linings, thus automatically connecting the cells in series.

980,843. MOUNTING OF CONDUCTORS. Karl Schroter, Berlin, Germany, assignor to General Electric Company. Filed May 20, 1910. The process consists in applying to a filament-supporting system a protective coating adapted to receive deposits of materials expelled from the filament during passage of current therethrough and to be removed with them.

980,844. VOLTAGE REGULATION OF DYNAMO-ELECTRIC ALTERNATING-CURRENT MACHINERY. Michael Seidner, Budapest, Austria-Hungary, assignor to Aktiengesellschaft Brown Boveri & Cie., Baden, Switzerland. Filed July 29, 1910. A closed regulating-resistance circuit has alternating-current leads connected to equipotential points thereof as regards direct current and direct-current leads connected to equipotential points thereof as regards alternating current.



980,707.—MOTOR CONTROL.

980,851. ELECTRIC APPARATUS FOR MEASURING AND INDICATING SIZES OF TILES, ETC. William B. Updegraff, New York, N. Y. Filed June 17, 1910. A feeler arranged to contact with an edge of the tile actuates a circuit-closer, which moves along a series of contacts and closes one of a set of size-indicating circuits.

980,857. PARTY-LINE TELEPHONE EXCHANGE. Clarence A. Anderson, Salina, Kans., assignor to Anderson Electric & Manufacturing Co., Wichita, Kans. Filed February 28, 1910. A lock-out system has a selector at central with a series of station-selecting keys, the manipulation of one of which connects a power drive to the selector.

980,863. ELECTRIC SWITCH. George A. Burnham, Saugus, Mass., assignor to S. B. Condit, Jr., Boston, Mass. Filed April 25, 1910. The switch members are of spring metal and the contact is made and broken under oil.

980,865 and 980,866. CONTROLLER-REGULATOR. Cyrus P. Ebersole, Keokuk, Iowa, assignor to American Automotoneer Company, Philadelphia, Pa. Filed July 8, 1905 and October 11, 1906. Comprises a stationary zigzag way, a hood rotatably mounted over the way and having a housing, and a dog having a ball and socket connection in the housing and co-operating with the way.

980,883. TELEPHONE EXCHANGE. Nils Emel Norstrom, Chicago, Ill., assignor to Anderson Electric & Manufacturing Company. Filed February 23, 1909. A device arranged to send impulses alternately in opposite directions over a party line, has means for breaking the impulses in one direction up into very short impulses, and automatically operating means for preventing selected ones of such impulses from being so broken up.

980,884. LIGHTNING-ARRESTER. Nils Emel Norstrom, Chicago, Ill., assignor to Anderson Electric & Manufacturing Co., Wichita, Kans. Filed October 14, 1905. Renewed August 28, 1909. A carbon block is connected to each line wire and a third one to ground and mounted on a spring.

980,885. CABLE BOX. Nils Emel Norstrom, Chicago, Ill., assignor to Anderson Electric & Manufacturing Co., Wichita, Kans. Filed March 22, 1907. Renewed June 15, 1910. Contains a series of the arresters described above.

980,886. TELEPHONE EXCHANGE. Samuel A. Norstrom, Chicago, Ill., assignor to Anderson Electric & Manufacturing Co., Wichita, Kans. Filed November 13, 1905. Renewed February 10, 1909. A party-line exchange has a device for sending a series of impulses over the line, means by which one or more cessations of impulses are caused to occur at pre-determined points and of specified duration in the series of impulses and means by which a station is telephonically connected to the line as the result of such cessation of impulses, the particular station so selected being determined by the location of the cessation of impulses in the whole series of impulses.

REISSUE.

13,189. SIGN. Christie S. Neville, Chicago, Ill. Filed May 9, 1910. Original No. 914,064, dated March 2, 1909. A pair of outwardly-facing centrally-apertured concave disks, has an electric lamp located between the disks and in line with their apertures, a reflector located centrally in front of each disk and arranged to reflect light rays from the lamp upon the disk surface.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired January 9:

512,265. APPARATUS FOR PRODUCING OZONE BY ELECTRICITY. Emile Andreoli, London, England.

512,316. ELECTRIC VALVE CONTROLLER. Charles E. Ongley, New York, N. Y.

512,320. ELECTRIC INCANDESCENT LAMP. John Peil and Carl K. McFadden, Chicago Ill.

512,327. ELECTRICALLY-PROPELLED VEHICLE. James H. Rogers and Willard Fracker, Washington, D. C.

512,331. ELECTRIC CUT-OUT. Albert P. Seymour, Syracuse, N. Y.

512,340. COIL FOR ELECTROMAGNETS. Nicola Tesla, New York, N. Y.

512,373. TROLLEY CUT-OUT. Melancthon Hanford, Malden, Mass.

512,386. ELECTROMAGNET. Frank R. McBerty, Downer's Grove, Ill.

512,397. SPARK-REGULATOR FOR DYNAMO-ELECTRIC MACHINES. Charles E. Scribner, Chicago, Ill.

512,398. APPARATUS FOR TELEPHONE-SWITCHBOARDS. Charles E. Scribner, Chicago, Ill.

512,399. APPARATUS FOR TELEPHONE-SWITCHBOARDS. Charles E. Scribner, Chicago, Ill.

512,400. AMERICAN DISTRICT ELECTRIC SIGNAL APPARATUS. Charles E. Scribner, Chicago, Ill.

512,401. DUPLEX ARC LAMP. Charles E. Scribner, Chicago, Ill.

512,413. TELEPHONE-CALL RECORDER. William B. Thomson, Chicago, Ill.

512,422. PRINTING-TELEGRAPH. Emil A. Wirsching, New York, N. Y.

512,424. ALTERNATING-CURRENT DYNAMO. James J. Wood, Fort Wayne, Ind.

512,425. CONNECTION BETWEEN SEPARATELY-EXCITED DYNAMOS AND THEIR EXCITERS. James J. Wood, Fort Wayne, Ind.

512,444. CLOSED-CONDUIT RAILWAY. Charles J. Kintner, New York, N. Y.

512,448. SOCKET FOR INCANDESCENT LAMPS. Thomas L. Pfarr, Jr., Pittsburg, Pa.

512,454. TIME-INDICATOR FOR TELEPHONES. Charles Stever, San Jose, Cal.

512,464. INCANDESCENT LAMP. Augustus C. Carey, Lake Pleasant, Mass.

512,473. SECONDARY BATTERY. Frank K. Irving, New York, N. Y.

512,481 and 512,482. ELECTRIC ARC LAMP. Regina Niewerth, Berlin, Germany.

512,514. ELECTRODE FOR SECONDARY BATTERIES. William Morrison, Des Moines, Iowa.

512,535. ELECTRIC-RAILWAY CURRENT-COLLECTOR. Eben M. Boynton, West Newbury, Mass.

512,567. BATTERY. Wilbur M. Stine, Athens, O.

512,602. FURNACE FOR HEATING OR WORKING METALS ELECTRICALLY. Charles L. Coffin, Detroit, Mich.

512,603. ELECTRICAL TRANSFORMER OR CONVERTER. Charles L. Coffin, Detroit, Mich.

512,604. APPARATUS FOR ELECTRICALLY WELDING METAL. Charles L. Coffin, Detroit,Mich.

512,612. DEVICE FOR BLOWING OUT SPARKS ON COMMUTATORS OF DYNAMOS. Hamilton W. Hanahan, Winnsborough, S. C.

512,614. ELECTRIC SWITCH. Jesse L. Hinds, Syracuse, N. Y.

512,636. REFLECTOR FOR ELECTRIC LAMPS. Joseph W. Turnbull, Pascagoula, Miss.

512,637 INCANDESCENT ELECTRIC LAMP. Joseph W. Turnbull, Pascagoula, Miss.

512,667. DOUBLE-CARBON ARC LAMP. Charles E. Scribner, Chicago, Ill.